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NATIONAL DAM INSPECTION PROGRAM. UPPER DAM (NDI NUMBER PA-00445--ETC(U)
SEP 80 S G MAZZELLA, J P HANNAN, J E BARRICK DACW31-80-C-0026

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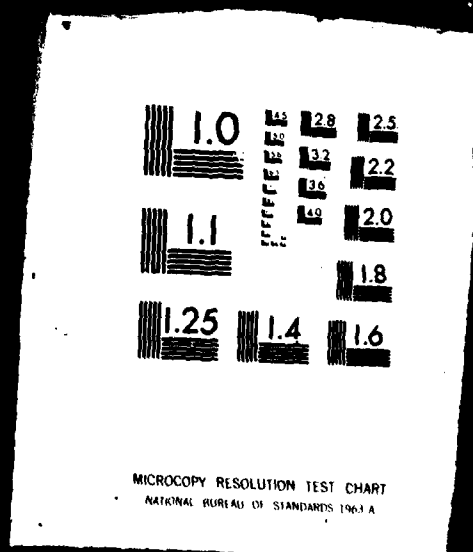
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National Dam Inspection Program

SUSQUEHANNA RIVER BASIN

UPPER DAM

CENTRE COUNTY, COMMONWEALTH OF PENNSYLVANIA

(NDI NO. PA-00445, Number
PENNDER NO. 14-25)

Susquehanna River Basin, Cold Stream,
Centre County, Pennsylvania.

KEYSTONE WATER COMPANY

PHASE I INSPECTION REPORT

⑪ Sep 80

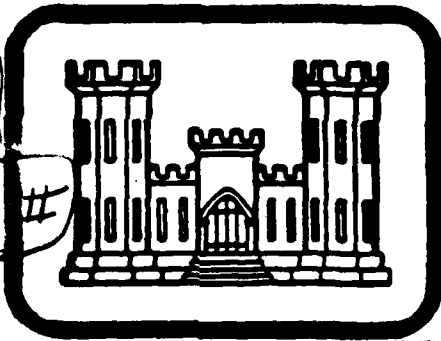
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⑬ DAW 31-80-C-0026

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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Date: September 1980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

| | |
|---------------------|------------------------------------|
| NAME OF DAM: | Upper Dam |
| STATE LOCATION: | Pennsylvania |
| COUNTY LOCATION: | Centre |
| STREAM: | Cold Stream |
| DATE OF INSPECTION: | 8 May 1980 |
| COORDINATES: | Lat. 40°51'00", Long. 78°12'30" |

ASSESSMENT

Based on a review of available design information, visual observations of conditions as they existed on the date of the field inspection, and engineering analyses performed, the general condition of Upper Dam is considered to be good.

The structure is classified as a "small" size, "high" hazard dam. Corps of Engineers guidelines recommend one half to one times the Probable Maximum Flood (PMF) as the Spillway Design Flood for a "small" size, "high" hazard dam. Upper Dam's Spillway Design Flood is one half the Probable Maximum Flood. Spillway capacity is "adequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be 84 percent of the PMF.

RECOMMENDATIONS

1. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

- a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff.
- b. Procedures for around the clock surveillance during periods of heavy precipitation or runoff.
- c. Procedures for monitoring the quantity and quality of seepage in the pond drain conduit and the PVC seep pipe.
- d. Procedures for drawdown of the reservoir under emergency conditions.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Upper Dam

e. Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

2. Remedial Work: The Phase I investigation of Upper Dam disclosed several minor deficiencies which should be corrected during routing maintenance. These include:

a. Repair of the slough on the downstream toe of the embankment near the chlorination house.

b. Revegetation of barren areas on the crest, downstream slope, downstream toe area and abutments.

c. Repair of concrete cracks and deterioration.

d. Backfill the animal burrow beneath the spillway bridge.



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12 Sept. 80
Date

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Date

Approved by:

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

24 Sep 80
Date

UPPER DAM



OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
UPPER DAM
NATIONAL I. D. NO. PA 00445
PennDER No. 14-25

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances:

(1) Embankment: Upper Dam was designed and constructed as an earthfill structure with a concrete foundation cutoff wall. The wall is 18 inches thick and is located about midway between the crest and the upstream toe of the embankment. The upstream slope has a concrete slab paving that ties into the cutoff wall. A 3.25 foot high concrete parapet wall rises from the top of the concrete slab and extends across the crest from the spillway to the right abutment.

The embankment is 240 feet long (excluding spillway), 17.2 feet high, and has a crest width of 8 feet, including parapet wall. The upstream slope is 2.3H:1V above the water line and the downstream slope is 2.1H:1V.

(2) Pond Drain: The pond drain consists of a gate valve controlled 30 inch diameter CMP outlet pipe that discharges to a channel below the toe of the embankment. The pond drain inlet pipe is 20 inch diameter cast iron with an intake headwall above the upstream toe of the embankment.

The gate valve control is located upstream of the embankment centerline, in the gate house.

X

(3) Water Supply Pipeline: The water supply pipeline is 16 inch diameter cast iron with intake headwall on the embankment's upstream slope. Flow is controlled at the gate house by a slide gate. Also, a high level water supply intake is provided by slide gate at the gate house.

(4) Principal (and Emergency) Spillway: The principal (and emergency) spillway is a concrete surfaced, open channel on the left abutment. The spillway overflow crest is 54.5 feet long and has 8.7 feet of freeboard. Two foot high flashboards are normally placed in the spillway to increase reservoir capacity.

The discharge channel is a concrete chute that turns 45° at the downstream end. Chute blocks have recently been installed to improve emergency dissipation characteristics.

b. Size Classification: The dam has a maximum storage capacity of 172 acre-feet and a maximum toe to crest height of 17.2 feet. Based on the Corps of Engineers guidelines, this dam is classified as a "small" size structure.

c. Hazard Classification: Upper Dam is classified as a "high" hazard dam. In the event of a dam failure, at least twenty two inhabited dwellings on the floodplain below the dam would be subjected to substantial damage and loss of life could result.

d. Ownership: Upper Dam is owned by the Keystone Water Company. Correspondence should be addressed to:

Keystone Water Company
Moshannon District
323 North Front Street
Philipsburg, Pennsylvania 16866
Attention: Mr. J. L. Settelen
(814) 342-2190

e. Purpose of Dam: Upper Dam was constructed to provide a water supply reservoir for Philipsburg, Pennsylvania.

f. Design and Construction History: The dam was designed by Morris Knowles, Consulting Engineer, of Pittsburgh, Pennsylvania in 1916. A permit to construct a dam across Cold Stream was issued by the Water and Power Resources Board (predecessor to PennDER) on 20 December 1916.

Construction was begun in 1917 and, due to the financial condition of the water company, was not finished until 1921. The constructor of the dam is not known. A Morris Knowles representative was on-site during construction work.

g. Normal Operating Procedure: Upper Dam was designed to operate as an uncontrolled structure. Under normal operating conditions, the pool level is maintained at Elev. 1613.1 by the flashboard of the principal spillway. A water supply pipeline through the dam provides water and pressure head for the Philipsburg water supply system. The pipeline is normally operative and under full head. A pond drain through the embankment provides for reservoir drawdown. The pond drain is normally not operative, and its flow control is in the gate house upstream of the dam.

(4) Downstream Conditions: Cold Stream below Upper Dam passes through a relatively narrow, steep-sided, uninhabited valley for the first 4000 feet. Approximately 1000 feet below the dam, Cold Stream flows through the remnants of an earth and masonry dam. The dam is about 10 feet high and about 120 feet wide and impounds a lake approximately 500 feet long. The dam contains a large breach which developed during Hurricane Agnes in 1972 .

Within the next mile downstream, at least twenty two inhabited dwellings lie on the floodplain. About 3.4 miles downstream , Cold Stream enters a lake (Recreation Dam) on the outskirts of Philipsburg. About one mile below Recreation Dam, Cold Stream flows into Moshannon Creek which eventually flows into the West Branch of the Susquehanna River about 14 miles north east of Philipsburg.

(5) Reservoir: Upper Dam's Reservoir is 1800 feet long at normal pool elevation and has a normal surface area of 10 acres. When the pool is at the crest of the dam, the reservoir length increases to 1950 feet and the surface area is 11.9 acres.

(6) Watershed: The Watershed contributing to Upper Dam is almost completely wooded and uninhabited. At least two-thirds of the watershed lies within State Gamelands No. 33.

b. Location: Upper Dam is located in Rush Township, Centre County, Pennsylvania, approximately 3.4 miles south of the center of Philipsburg, Pennsylvania.

1.3 PERTINENT DATA

- a. Drainage Area: 9.6 sq. mi.
- b. Discharge at Dam Facility:
- | | |
|---|--|
| Maximum Flood at Dam Facility | Depth of 4.5 feet in Spillway, 18 March 1936 |
| Principal (and Emergency) Spillway Capacity at Top of Dam | 4087 cfs |
- c. Elevation (feet above MSL)**
- | | |
|--|----------|
| Design Top of Dam | 1619.75* |
| Current Top of Dam (minimum) | 1619.2 |
| Operating Pool (without Flashboards) | 1613+ |
| Principal (and Emergency) Spillway Crest | 1611.0* |
| Normal Pool (without Flashboards) | 1611.0* |
| Water Supply Pipeline Inlet Invert | 1601+* |
| Pond Drain Inlet Invert | 1597+* |
| Embankment Downstream Toe | 1602 |
| Pond Drain Outlet Invert | 1595.3* |
- d. Reservoir Length
- | | |
|------------------------|-----------|
| Length of Maximum Pool | 1950 feet |
| Length of Normal Pool | 1800 feet |
- e. Reservoir Storage
- | | |
|--|---------------|
| Current Top of Dam | 172 acre-feet |
| Principal (and Emergency) Spillway Crest | 80 acre-feet* |
| Normal Pool | 80 acre-feet* |
- f. Reservoir Surface
- | | |
|--|------------|
| Current Top of Dam | 11.9 acres |
| Principal (and Emergency) Spillway Crest | 10 acres* |
| Normal Pool | 10 acres* |
| Sediment Pool | 10 acres* |

g. Embankment

| | |
|-------------------|--------------------|
| Type | Earth |
| Length | 240 feet |
| Height | 17.2 feet |
| Crest width | 8 feet |
| Slopes | |
| Downstream | 2.1H:1V |
| Upstream | 2.3H:1V |
| Impervious core | Yes* |
| Cutoff provisions | Yes-concrete wall* |
| Grout curtain | Unknown* |

h. Principal (and Emergency) Spillway

| | |
|-------------------------|---|
| Type | Concrete Open Channel with Flashboards |
| Length of Weir | 54.5 feet |
| Approach Channel Slope | Unknown |
| Discharge Channel Slope | 11% |

i. Pond Drain

| | |
|-----------------------|----------------------------------|
| Type | 30 inch Diameter CMP Outlet |
| | 20 inch Diameter Cast Iron Inlet |
| Upstream Flow Control | Yes |
| Conduit length | Outlet-80 feet* |
| | Inlet-30 feet* |
| Anti-seep Collars | No* |

j. Water Supply Pipeline

| | |
|-----------------------|-----------------------------|
| Type | 16 inch Diameter Cast Iron* |
| Upstream Flow Control | Yes |
| Gate Valve | Yes |
| Anti-seep Collars | No* |

* Taken or derived from original specifications and/or drawings.

**To obtain elevations on Design Drawings, add 10 feet.

SECTION 2 ENGINEERING DATA

2.1 DESIGN

a. Data Available: The following written information and data may be obtained from the Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania. The information was reviewed for this study.

(1) Miscellaneous correspondence related to permit application requirements and approval conditions.

(2) Applications and permits for construction and modification of a dam owned by the Citizen's Water Company of Philipsburg, Pennsylvania.

(3) Set of design drawings by Morris Knowles, Consulting Engineer dated for 30 September 1916 through 17 January 1920.

(4) Specifications for dam construction dated 1916 and modifications, undated.

(5) Construction program reports by the consulting engineer and state personnel.

(6) Miscellaneous correspondence related to a proposed change in spillway and extension of the construction period.

(7) Miscellaneous correspondence related to the required spillway design capacity and drainage area discrepancy.

(8) Correspondence related to development and subsequent correction of an embankment piping condition in 1931.

(9) Design drawing dated 6 October 1943 indicating proposed repairs to upstream slope concrete slab.

(10) Design drawing by the American Water Works Service Company dated 27 February 1974 showing field elevations and locations of underwater pipes.

*Obtained from Keystone Water Company.

(11) Design drawings by the American Water Works Company dated 20 June 1977 showing spillway and intake structure improvements.

(12) Miscellaneous correspondence related to dam inspections of Upper Dam by Water and Power Resources Board personnel.

b. Design Features: The embankment and appurtenances were designed in accordance with Water and Power Resources Board criteria.

(1) Field Investigation: No predesign geotechnical investigation was performed at the site. However, the logs of three test pits are shown on the Morris Knowles design drawings. These test pits indicate the dam foundation material to be mostly sand and gravel with a small amount of clay.

(2) Embankment: The embankment was designed to be compacted earthfill with a concrete foundation cutoff wall. The specifications required a mix of earth or clay, gravel and boulders taken from the excavation of the spillway channel and wasteway or selected from the cutoff wall excavation. The fill was to have been placed in 6 inch layers and rolled with a roller weighing not less than 3/4 of a ton/foot width of roller.

The concrete cutoff wall was 18 inches wide and embedded into rock. The wall was to be located approximately halfway between the crest and the toe of the upstream slope. The upstream slope was to be paved with concrete on a coarse gravel subbase. The upstream slope was designed to be 2.5H:1V above the normal pool elevation with a 3.25 foot parapet wall at the crest of the embankment. The downstream slope was 2H:1V.

(3) Pond Drain: A 20 inch diameter cast iron pond drain was installed from an intake inlet above the embankment's upstream toe, through the gate house, and to a discharge point below the downstream slope. The downstream portion of the pipe was later replaced with 30 inch diameter CMP.

(4) Water Supply Pipeline: The specified water supply pipeline was 16 inch diameter cast iron that entered the gate house from a headwall on the embankment's upstream slope. The pipe inlet to the gate house was sluice gate controlled as was the pipe outlet from the gate house. Also, there was an upper sluice gate in the gate house wall to allow water supply intake from a higher level in the reservoir.

(5) Principal (and Emergency) Spillway: The original design specified a concrete lined spillway in an excavation on the left abutment. However, the designed structure was never built; it was initially replaced by a temporary timber structure. The temporary structure served during the construction pause of 1917-1919 and was then replaced by the current spillway structure.

The current structure has a width of 54.5 feet at the dam crest centerline which decreases to 25 feet at the original stream channel below. A six inch Terra Cotta drain tile was placed in the gravel bedding of the spillway slab to provide drainage.

2.2 CONSTRUCTION

a. Contractors: The name of the contractor who constructed Upper Dam is unknown.

b. Construction Period: The embankment and appurtenances were constructed between February 1917 and May 1921.

c. Field Changes: According to the correspondence there is no record of any field changes during the construction of Upper Dam; a temporary spillway was installed during a pause in construction between 1917 and 1919. The spillway was redesigned during the construction pause, after an error was discovered in the original watershed calculation. The new spillway was larger, so as to provide adequate discharge capacity for the facility.

d. Construction Inspection: On-site inspection was performed by representatives of the Commonwealth of Pennsylvania periodically during construction, from 10 August 1917 through completion of the structure on 2 May 1921. Throughout construction, the work was monitored by a representative of Morris Knowles, the design engineer.

2.3 MODIFICATION/REPAIR

In 1931, a piping problem developed in the embankment to the left of the "blow-off line" (pond drain). The situation apparently occurred when the pond drain was plugged "on account of leakage through the valve." Dye

tests indicated that leakage through the "breast" where the upstream slope met the foundation cutoff, was almost entirely discharged through the pond drain pipe. Repairs to both concrete and embankment were made.

In 1944, repairs were again made to the junction of the upstream slope protection slab and the foundation cutoff wall.

In 1977, several modifications were made to the spillway and gate house. The spillway modifications included placing a retaining wall on the right side of the lower end of the spillway and adding energy dissipation blocks at the end of the spillway channel. The modification was performed to control erosion along the embankment toe area due to the curvature in the spillway channel.

The modifications to the gate house included a new 16 inch gate valve and 3 new sluice gates, with new valve stems. The handwheel control area received new grating and new ladders were installed into the gate house.

2.4 OPERATION

According to the Water and Power Resources Board, the Keystone Water Company is responsible for the operation of Upper Dam.

The principal (and emergency) spillway is uncontrolled and performance and operation records are not maintained.

The pond drain is normally closed.

The water supply pipeline is normally open to supply water and pressure head to the water supply system of the City of Philipsburg. Periodic maintenance of the system is required to assure adequate chlorination.

The dam does not require a dam tender.

2.5 EVALUATION

a. Availability: Available design information and drawings were obtained from the Pennsylvania Department of Environmental Resources and were supplemented by conversation, information and drawings obtained through representatives of the Keystone Water Company.

b. Adequacy: The available design information supplemented by field inspection and supporting engineering analysis presented in succeeding sections, is adequate for the purpose of this Phase I Inspection Report.

c. Validity: Based on the available data, there appears to be no reason to question the validity of the available design information and drawings.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of the Upper Dam was performed on 7 May 1980, and consisted of:

(1) Visual observations of the embankment crest and slopes, groins and abutments;

(2) Visual observations of the principal (and emergency) spillway, outlet works structures, and pond drain facilities;

(3) Visual observations of the embankment's downstream toe areas including drainage channels, hydraulic structures, and surficial conditions;

(4) Visual observations of downstream conditions and evaluation of the downstream hazard potential.

(5) Visual observations of the reservoir shoreline and watershed;

(6) Transit stadia surveys of relative elevations along the embankment crest centerline, spillway, and across the embankment slopes.

The visual observations were made during a period when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field plan, profile and section containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections.

b. Embankment:

(1) Crest: The crest of the embankment was generally straight and flat and fully vegetated except for a short length of the path from the bridge across the spillway. No tension cracks or settlement conditions were observed in the crest. At the upstream edge of the crest, there is a concrete parapet wall that extends from

the right spillway training wall into the right abutment. The parapet wall was in generally good condition with some minor cracking observed around the construction joints. On the upstream side of the wall, a few areas of minor spalling were observed. Areas of patching and maintenance work done in the past were visible.

(2) Upstream Slope: The upstream slope of the embankment is paved with a concrete slab that lies below a masonry slab that has been coated with concrete. The general condition of the slab is good, though some cracks were noted and some minor spalling was observed. No large gaps or erosional distress was observed. No depressions or settlement of the slab was observed and there was no indication that the slab has been undercut.

(3) Downstream Slope: The downstream slope of the embankment was in generally good condition. It was almost entirely grass covered and appeared to be well maintained. Two paths traverse the downstream slope but neither appeared to be the source of any serious erosion.

A surficial slough was observed near the toe of the downstream slope near the right abutment. The slough appeared to have been repaired in recent time. The location of the slough was immediately above the chlorination house in an area where there was evidence of recent construction work.

The downstream slope was observed to be generally uniform and showed no slumping, bulging or other indications of instability.

The junction of the embankment and the lower right abutment (lower right groin) was observed to be somewhat ragged. The abutment has been cut away to provide for construction of the chlorination house resulting in a relatively steep slope. Some bare earth was observed but no erosion or seepage was noted.

The upper groin was observed to be in good condition. The groin in this area was heavily covered with small trees, brush, and ground vegetation.

The junction of the embankment and the spillway was observed to be in good condition with the exception of a minor erosional area immediately below the bridge

crossing. An animal burrow was noted beneath the rocks that formed the foundation for the bridge on the embankment side of the spillway.

The junction of the embankment and the downstream floodplain was observed to be in very good condition. A square barren area was noted at the toe of the embankment on the left side of the slope. Keystone Water Company officials indicated that a seep and wet area had recently been controlled by filter and pipe with the pipe now discharging to the pond drain outlet channel below. The barren area appeared to have been recently seeded.

d. Abutments:

(1) Right: The right abutment is generally flat and heavily wooded in the area above and below the embankment. No seepage or indications of slope instability were observed anywhere on the right abutment.

(2) Left: The left abutment is relatively steep and generally wooded. An erosional gully caused by apparent surface runoff cuts across the left abutment in the area immediately above the spillway bridge. The erosional distress appeared to be a long standing phenomenon. A barren footpath leaves the spillway bridge approach path and passes along the left spillway training wall to the area above the spillway. Some minor erosion has occurred along the path and behind the spillway near the spillway approach area. The erosional distress appears to be a long standing phenomenon.

(3) Downstream Toe Area: The downstream area below the toe of the embankment was observed to be in generally good condition. It was grass covered and well maintained.

Two seeps were observed below the embankment. One was the previously noted seep at the embankment toe area that was discharging from a one inch diameter PVC pipe.

The second seep was observed in the alluvial gravel of the channel bottom just below the spillway discharge channel. The origin of the second seep could not be determined but may have been water passing through the gravel from the channel above.

e. Pond Drain:

(1) Conduit: The observed portion of the pond drain conduit was a 30 inch diameter, uncoated corrugated metal pipe.

(2) Intake Structure: The inlet end of the pond drain was not observed due to the high reservoir pool level. However, the pond drain controls are located on the gate house. The handwheel controlling the pond drain was partially opened and discharge was observed at the outlet end of the pond drain conduit. The valve was then closed and operation was observed to be satisfactory.

(3) Outlet: The pond drain conduit discharges directly to an excavated channel. The pond drain outlet conduit has no headwall or no riprap erosion protection around the end of the drain pipe as it discharges into the channel.

A flow of approximately 10 gallons per minute was observed to be discharging from the pond drain pipe (with the valve closed). Discussion with Keystone Water Company personnel indicated that the discharge had continued unchanged for many years.

(4) Discharge Channel: The pond drain discharge channel is excavated into natural ground of the floodplain below the dam. The channel is gravel-lined with some larger rocks observed. Exposed soil surfaces have suffered some erosion, primarily due to runoff from the floodplain above the channel. The channel was straight and discharged directly into Cold Stream approximately 100 feet below.

(5) Instrumentation: No instrumentation was observed during the inspection.

f. Principal (and Emergency) Spillway:

(1) Weir: The flow control for the principal spillway is a sharp crested weir that is formed by steel flashboards located between the training walls of the principal spillway chute. The weir was 2 feet high and 54.5 feet long across the crest. A few sticks and brush debris were noted trapped on the edge of the weir but did not provide any significant disturbance to flows over the weir.

X

(2) Approach Channel: The approach channel was clear of obstructions and of sufficient width to permit full weir discharge. The channel approaches the weir at an angle and is contained by a concrete training wall on the abutment side.

(3) Discharge Channel: The principal spillway discharge channel consists of a reinforced concrete open channel chute through the left abutment. At the weir, the chute is 54.5 feet wide but converges to a width of 25 feet approximately 110 feet below the weir crest.

The right training wall of the weir is the original constructed concrete wall and appeared to be in good condition except for a few minor cracks and some minor erosion of concrete at the water line.

At the downstream end of the right training wall, a new reinforced concrete training wall has been constructed to divert channel flows back to the Cold Stream channel. Keystone Water Company officials indicated that the diversion was constructed to prevent a recurrence of erosion of the downstream floodplain area which occurred during Hurricane Agnes in 1972. Several cracks were noted at the junction between the old and new walls. The new wall was in excellent condition. Weep hole pipes placed near the toe of the wall were observed to be discharging very small amounts of water.

The spillway's left training wall in the vicinity and immediately below the weir was observed to be relatively new construction. The concrete observed was in good condition with no serious cracking or spalling.

Below the new section of wall, the left training wall is the original concrete wall of the discharge channel chute. The wall was observed to be tilted significantly inward toward the spillway and as with the older right training wall, some erosion at the water line has occurred. Otherwise the wall appeared to be stable and was in reasonably good condition. Keystone Water Company officials indicated that the wall had been in its tilted condition for many years. Close inspection of the backfill behind the wall revealed no indication of recent cracking or movement of the wall.

The discharge channel base slab is the original concrete slab placed at the time of construction of the spillway. The slab could not be observed closely because of flowing water. No construction joint openings, sinkholes, serious deterioration or spalling of concrete surfaces were noted. In general, water passed over the slab uniformly and without significant disturbance.

At the downstream end of the original spillway chute, a concrete block wall has been constructed near the center of the spillway channel. The left side of the spillway discharges to the original Cold Stream channel which is lined with large rocks in the vicinity. The right side of the channel continues over a poured concrete slab into area where the new training wall has been constructed. Discharge from the right portion of the channel is then over a chute block energy dissipation structure to the original Cold Stream channel.

(4) Bridge: An access bridge for pedestrian traffic crosses the spillway at about mid-height on the earthen embankment. The bridge is constructed of steel I-beams with a wooden deck and steel pipe handrail. The bridge foundation consists of rocks and bricks that are set atop the spillway training walls. The bridge was observed to be in excellent condition.

g. Downstream Conditions:

(1) Downstream Channel: The Cold Stream channel immediately below the spillway discharge channel is straight and wide and completely unobstructed for a distance of approximately 400 feet. The channel bottom is surfaced with alluvial gravel and has no detrimental vegetation near the shorelines. Immediately below the left end of the discharge channel, some bank erosion has occurred. However, the erosion is not serious and it appears that some large rocks have been placed in the vicinity to retard further erosional problems.

Below the clear channel reach, Cold Stream enters the impoundment area of an abandoned lake, passes through a breach in the abandoned dam and returns to the original Cold Stream channel below.

(2) Floodplain Development: In the first 1.5 miles below the dam, at least 22 inhabited dwellings lie on the floodplain at elevations low enough to possibly be affected by a dam failure. Also, State Route 332, a major north-south highway would be threatened by failure of the dam.

h. Reservoir:

(1) Slopes: The reservoir's right shoreline is moderately steep and heavily wooded for its entire length. Some minor shoreline erosion has occurred in the reach immediately upstream of the dam, but no serious slumping of the shoreline was noted.

The reservoir's left shoreline is bounded by generally flat slopes and is also heavily wooded. No shoreline distress was observed along the left side of the reservoir.

(2) Sedimentation: No significant indications of sedimentation were observed during the field inspection. However, American Water Works Company officials indicated that the reservoir is heavily sedimented and its capacity has been significantly reduced. Because of a lack of access, the inlet stream and upstream sediment conditions could not be observed.

(3) Watershed: The watershed tributary to the reservoir was observed to be more or less as indicated on the U.S.G.S. topographic map, that is, mostly woodland lying on the side and along Sandy Ridge. An active mine was observed in the upper end of the watershed, but the surface area of disturbance comprised only a small part of the watershed.

3.2 EVALUATION

a. Embankment: The Upper Dam's embankment is considered to be in good condition. A few minor deficiencies were noted that should be corrected.

b. Pond Drain: The pond drain was observed to be operative and in good condition. The uncontrolled discharge from the conduit was clear and reported to have had a constant discharge rate over many years.

c. Principal (and Emergency) Spillway: The principal (and emergency) spillway was observed to be in good condition with only minor deficiencies noted.

d. Hazard Potential: Based on observations of downstream conditions, Upper Dam was assigned a "high" hazard potential rating.

SECTION 4 OPERATIONAL FEATURES

4.1 PROCEDURE

Reservoir pool level is maintained by the flashboards on the principal spillway.

Normal operating procedure does not require a dam tender.

The dam is visited daily by an employee of the water company to inspect the operation of the chlorination house at the toe of the embankment.

The pond drain is normally closed and the water supply pipeline normally open.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are maintained by the Keystone Water Company. Maintenance reportedly consists of periodically repairing eroded areas and making miscellaneous necessary repairs.

4.3 INSPECTION OF DAM

The Keystone Water Company is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

4.4 WARNING SYSTEM

There is no warning system and no formal emergency procedure to alert or evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

The operating facilities at Upper Dam are considered to be adequate. The maintenance program should be continued. However, there are no written operation, maintenance or inspection procedures, nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions, and should be implemented as necessary.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Upper Dam has a watershed of 6,150 acres which is vegetated primarily by woodland. The watershed is about 4.5 miles long and two miles wide and has a maximum elevation of 2,515 feet (MSL). At normal pool the dam impounds a reservoir with a surface area of 10 acres and a storage volume of 50 acre-feet. Normal pool level is maintained at Elev. 1611 by the principal spillway crest.

Spillway capacity and embankment freeboard were made sufficient to accommodate 3,500 cubic feet per second which was considered sufficient for this structure and watershed at the time of design. No additional design hydrologic calculations were found relating reservoir-spillway performance to the Probable Maximum Flood or fractions thereof.

b. Previous Phase I Investigation: A hydrologic analysis for Upper Dam (called Philipsburg Reservoir) was performed as part of a Phase I investigation for Recreation Dam (NDI PA 00445, PennDER 14-26) completed in March 1979. The results of this study indicated that Upper Dam would be overtopped for 6 hours and 40 minutes with a maximum overtopping depth of 2.26 feet by a PMF for the Recreation Dam. For one-half PMF, the duration determined was 2 hours and 10 minutes with a maximum depth of 0.38 feet. These conditions resulted from computed inflows of 9247 cfs and 4623 cfs for the PMF and one-half PMF respectively.

c. Experience Data: Records are not kept of the reservoir level or rainfall amounts. There is no record or report of the embankment ever being overtopped. However, there is record of a significant flow in the "wasteway" channel during the storm of March 1936. The flow depth, 4.5 feet, corresponds to a water surface elevation of 1615.4. The "blow off line" (pond drain) was open during the storm and until normal conditions returned.

d. Visual Observations: On the date of the field inspection, no serious deficiencies were observed that would prevent the principal spillway from functioning. For analysis purposes, it was assumed that the flashboards failed at the onset of the storm.

e. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend 0.5 to 1 times the Probable Maximum Flood (PMF) for "small" size, "high" hazard dams. Based on dam size and observed downstream conditions, Upper Dam has a Spillway Design Flood (SDF) of one-half the PMF.

Hydrometeorological Report No. 40 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 17.6 inches. An evaluation of the reservoir/spillway system was performed to determine whether the dam's spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Upper Dam was determined by HEC-1 to be 4,883 cfs for a full PMF. The peak inflow for the SDF was 2,441 cfs.

An initial pool elevation of 1,611 was assumed prior to commencement of the storm.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 0.84 PMF by HEC-1. At the SDF, Upper Dam is not overtopped. According to Corps of Engineers' guidelines, Upper Dam's spillway is "adequate."

SECTION 6
STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed. The dam and appurtenances were designed by Morris Knowles, Consulting Engineer, of Pittsburgh, Pennsylvania in 1916. There were no structural design calculations available for review. A detailed list of available information is found in Appendix B.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Post-Construction Changes: In 1931, a leak developed at the intersection of the cutoff wall and paving of the upstream slope. A new seal was designed and installed.

Modifications made in 1977 included gate house and spillway discharge channel improvements.

d. Visual Observations: The field inspection disclosed no evidence of potential instability of the embankment or its components. A minor slough was noticed at the embankment's toe near the chlorination house. This was assessed to be due to the modifications performed in 1977 and it appeared to be superficial.

There was no evidence of anomalous seepage through the embankment. The uncontrolled discharge from the pond drain outlet is believed to be of the same origin as that seepage traced by dye studies in 1931. Regardless, its quantity has reportedly been constant for years, and its quality was observed to be clear.

The left spillway wall near the downstream end of the spillway was tilted toward the spillway channel. The owner's representative reported that this condition has existed for many years.

e. Performance: Records indicate no observed signs of slope instability. The embankment seepage condition that developed in 1931 was corrected. There

were no other reports of any problems associated with the stability of the embankment or appurtenances over the 59 year life of the structure.

6.2 EVALUATION

a. Design Documents: The design documentation, was by itself, considered inadequate to evaluate the structure. No structural calculations were available for review.

b. Embankment: Based on results of the visual inspection that included observations of embankment slopes, materials, seepage and groundwater conditions, Upper Dam appeared to be stable.

c. Principal Spillway: Based on results of the visual inspection, the principal spillway structure for Upper Dam appeared to be stable.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Upper Dam is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. No calculations were developed to verify this assessment, however.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Upper Dam's embankment is considered to be in good condition. This is based on visual observations that revealed only minor deficiencies.

(2) Pond Drain: The condition of the Pond Drain is considered to be good. The drain has an upstream slide gate and its satisfactory operation was observed during the field inspection.

(3) Principal Spillway: The condition of the principal spillway is considered to be good. This is based on its "adequate" capacity rating determined using the HEC-1 computer program and its observed satisfactory physical condition.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations and hydrology and hydraulic calculations was sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I investigation guidelines.

c. Urgency: The recommendations presented in Section 7.2a and 7.2b should be implemented immediately.

7.2 RECOMMENDATIONS

a. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for monitoring the quantity and quality of seepage in the pond drain conduit and the PVC seep pipe.

(4) Procedures for drawdown of the reservoir under emergency conditions.

(5) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

b. Remedial Work: The Phase I Investigation of Upper Dam disclosed several minor deficiencies which should be corrected during routine maintenance. These include:

(1) Repair of the slough on the downstream toe of the embankment near the chlorination house.

(2) Revegetate barren areas on the crest, downstream slope, downstream toe area and abutments.

(3) Repair of concrete cracks and deterioration.

(4) Backfill the animal burrow beneath the foot bridge.

APPENDIX A
VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name Dam Upper Dam County Centre State Pennsylvania National ID # PA 00445

Type of Dam Earthfill and Concrete Hazard Category High

Date (s) Inspection 8 May 1980 Weather Cloudy, cool Temperature 50°F

Pool Elevation at Time of Inspection 1613.4 (MSL)
Tailwater at Time of Inspection 1595.3 (MSL)

Inspection Personnel: J. E. Barrick, P.E. Ackenheil & Associates, Hydrologist and Project Manager.
J. P. Hannan Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella Ackenheil & Associates, Civil Engineer
G. L. Van Balen Ackenheil & Associates, Hydraulic Engineer
J. L. Settelen Manager, Moshannon District, Keystone Water Co.
W. E. Hutcheson, American Water Works Service Co., Inc., Director of Risk and Materials Management
B. Juergens American Water Works Service Co., Inc., Director of Engineers

Recorder J. E. Barrick

GEO Project G79153-X
PENNDER I.D. No. 14-25

EMBANKMENT

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|--|--|----------------------------|
| SURFACE CRACKS | No surface cracks observed in earthen portion of embankment crest and slope. Some minor cracking observed on concrete parapet wall and upstream slope protection. | |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | None observed. | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | <p>A minor surficial slough was observed near the right end of the embankment immediately adjacent to the chlorination house at the toe of the dam. The slough appeared to be the result of recent construction work around the chlorination house at the toe of dam. The slough has been recently reseeded.</p> <p>Some erosion was noted on the left abutment beyond the left spillway training wall. A surface runoff drainage channel has eroded a channel in the left abutment immediately above the path leading to the bridge over the spillway. The condition is not serious.</p> <p>Some minor erosion has occurred in the abutment slope immediately below the embankment at the right end of the embankment behind the chlorination house. The erosion does not appear to be serious.</p> <p>Minor erosion has occurred on the embankment slope where a path leads from the gate house structure down the embankment slope to the chlorination house.</p> | |

EMBANKMENT (CONTINUED)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|---|--|---|
| <u>VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST</u> | The crest of the embankment was observed to have the proper horizontal alignment and was observed to be approximately level. The concrete parapet wall, at the upstream edge of the slope, was observed to be straight and generally level though local undulations have resulted in low points along the crest. | |
| <u>RIPRAP FAILURE</u> | No riprap observed. | |
| <u>SETTLEMENT</u> | None observed. | |
| <u>JUNCTION OF EMBANKMENT AND ABUTMENT SPILLWAY AND DAM</u> | The junction of the embankment and right abutment was observed to be in good condition with no evidence of seeping water or erosional conditions existing. The groin in this area is heavily vegetated with small trees, brush, and ground cover vegetation. The groin terminates near the toe of the embankment at a steep face where excavation of the abutment has occurred in the past to permit construction of the chlorination house. Some bare earth is apparent, but no indications of significant erosion and no indication of seepage at all. | The junction of the embankment and the right spillway training wall is observed to be in good condition being entirely grass covered with the exception of a bare area immediately below the steps from the bridge across the spillway. An animal burrow was observed beneath the rocks that formed the foundation of the bridge at the contact with the right training wall. |

EMBANKMENT (CONTINUED)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|--|---|-----------------------------------|
| <u>JUNCTION OF EMBANKMENT AND ABUTMENT SPILLWAY AND DAM (CONT'D)</u> | The junction of the left abutment and the left spillway training wall was observed to be in generally good condition throughout its length. Some erosion has occurred behind the spillway wall near the crest of the spillway. The erosion appears to be the result of diversion and channeling of surface runoff from the abutment above. Erosion is not serious and is partially grassed indicating a long term condition. | |
| <u>ANY NOTICEABLE SEEPAGE</u> | A one inch diameter PVC pipe was observed to be discharging into the pond drain channel immediately below the pond drain outlet. The estimated flow from the pipe was 1 gallon per minute. Keystone Water Company officials indicated the source of the water in the PVC pipe to be an old seep near the downstream toe of the embankment. The water has recently been collected into the pipe for discharge at the outlet channel. | |
| <u>STAFF GAGE AND RECORDER</u> | None observed. | |
| <u>DRAINS</u> | See "Any Noticeable Seepage" above. | |
| <u>CONCRETE CONDITION</u> | The upstream slope protection and parapet were in generally good condition. Some minor cracking and deterioration noted. Structures appeared to be maintained and repaired when necessary. | |

OUTLET WORKS (POND DRAIN)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|---|--|-----------------------------------|
| CRACKING AND SPALLING OF CONCRETE SURFACES | Outlet conduit observed to be 30 inch diameter corrugated metal pipe uncoated. | |
| INTAKE STRUCTURE | The intake structure consists of a slide gate on the upstream end of the pond drain conduit. Valve control for the slide gate is at the gate house on the upstream slope of the embankment. Operation of the handwheel controlling the valve resulted in flow discharge from the pond drain outlet into the outlet channel below. Closure of the valve indicated satisfactory functioning. | |
| OUTLET STRUCTURE | The 30 inch CMP pond drain conduit discharges directly to an excavated earth channel below the toe of the embankment. There is no headwall and no stone protection surrounding the pipe. | |
| OUTLET CHANNEL | The outlet channel is excavated into natural ground at the toe below the embankment. The outlet channel is lined with gravel and rock and some earth was exposed. Some erosion has occurred due to surface runoff from areas above the channel. The condition is not considered serious and not detrimental to performance of the outlet channel. | |
| EMERGENCY GATE | See "Intake Structure" above. | |

OUTLET WORKS (WATER SUPPLY LINE)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|---|-----------------------------------|
| <u>CONDUIT</u> | Conduit not observed due to reservoir pool level. | |
| <u>INTAKE STRUCTURE</u> | The intake structure for the water supply pipeline is a reinforced concrete gate house structure constructed into the embankment's upstream slope. Three handwheels were observed that were reported to be controls for the intake to the water supply pipeline. Valve controls were not operated so as not to disrupt the water supply of the city of Philipsburg. | |
| <u>OUTLET STRUCTURE</u> | None observed. | |
| <u>EMERGENCY GATE</u> | See "Intake Structure " above. | |

PRINCIPAL (AND EMERGENCY) SPILLWAY

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|---------------------|-----------------------------------|
|------------------------------|---------------------|-----------------------------------|

WEIR

The principal spillway flow control device is a sharp crested weir contained between reinforced concrete wingwalls of the spillway chute. The weir is approximately 2.1 feet high and discharges directly to the concrete slab of the spillway chute below. Width of the weir crest is 54.5 feet. Minor amounts of debris including small branches were observed on or about the weir but did not affect performance of the weir. The weir appears to be a flashboard arrangement placed in the spillway channel to maintain the pool level and provide discharge capacity for both normal and storm flows. Four steel bars are embedded in the concrete of the approach slab to the weir. The bars serve to collect large debris that may enter the spillway approach channel.

DISCHARGE CHANNEL

The discharge channel is contained between reinforced concrete training walls and has a concrete slab bottom. The walls converge near the midpoint of the downstream slope and turn approximately 45° to the right. The chute below discharges to the original Cold Stream channel below. The training wall on the upper left portion of the spillway was observed to be relatively new and in good condition. The lower portion of the left training wall is considerably older and somewhat tilted toward the discharge channel. Some deterioration of the concrete was observed at the waterline. Also, some minor cracking of the lower left wall. The training wall along the upper length of the right side of the spillway is reported to be original spillway wall and also showed some minor deterioration along the waterline. At the downstream toe of the right training wall, a new reinforced concrete training wall has been

PRINCIPAL (AND EMERGENCY) SPILLWAY (CONTINUED)

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|---|---|-----------------------------------|
| <u>DISCHARGE CHANNEL</u> (CONTINUED) | <p>constructed at and below the point at which the spillway discharge channel flows are turned 45° for discharge to the Cold Stream channel below. The new wall is in excellent condition. Minor cracks were noted at the junction of the old wall and the new wall. The new wall contains a number of weepholes, several of which appeared to be discharging small amounts of water.</p> <p>At the end of the original spillway channel, a concrete blocked wall has been constructed at the center of the channel. On the right side, discharge is directly to the rock lined Cold Stream channel. On the left, the concrete slab is continued into the area where the new training wall has been constructed and discharge is over three chute blocks to the Cold Stream channel below. The discharge channel slab was observed to be in reasonably good condition. No open joints, sinkholes or significant deterioration of slab or joints was observed.</p> | |
| <u>BRIDGE AND PIERS</u> | <p>A wood deck bridge spanning the spillway on two steel beams was observed to be in very good condition. The bridge is set on rocks which are founded on the top of the concrete training wall.</p> | |

RESERVOIR

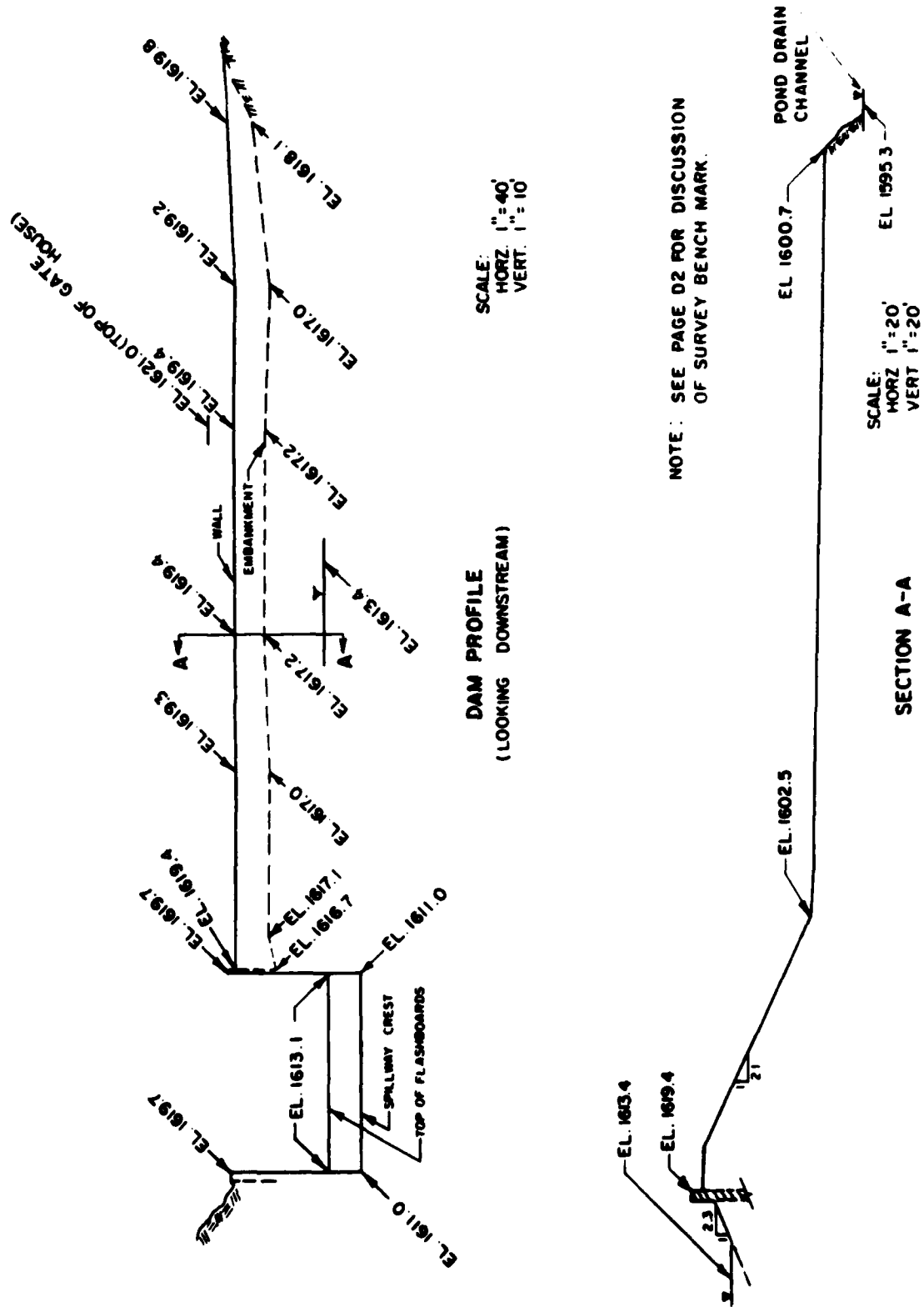
| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|--|-----------------------------------|
| <u>SLOPES</u> | <p>The left side of the reservoir was observed to have generally mild to moderate slopes which were heavily wooded for the entire length of the reservoir. No indications of sloughing of the left reservoir slope was observed.</p> <p>The right reservoir slope is moderately steep and also heavily wooded. Some minor erosion was observed immediately behind the dam apparently as the result of reservoir wave action. However, no sloughing or slumping of reservoir slopes was observed.</p> | |
| <u>SEDIMENTATION</u> | <p>None observed. Discussion with Mr. Juergens indicates that the reservoir contains a considerable amount of silt throughout its entire length.</p> | |
| <u>INLET STREAM</u> | <p>Not observed.</p> | |
| <u>WATERSHED</u> | <p>The watershed was observed to be more or less as indicated on the U.S.G.S. topographic map. The watershed is almost entirely wooded being located on the northwest slope of Sandy Ridge (Elevation 2500).</p> | |

INSTRUMENTATION

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|------------------------------|---------------------|-----------------------------------|
| MONUMENTATION/SURVEYS | None observed. | |
| WEIRS | None observed. | |
| PIEZOMETERS | None observed. | |
| OTHER | | |

DOWNSTREAM CHANNEL

| <u>VISUAL EXAMINATION OF</u> | <u>OBSERVATIONS</u> | <u>REMARKS OR RECOMMENDATIONS</u> |
|---|--|-----------------------------------|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | <p>The downstream channel, immediately below the discharge channel for the spillway, is straight and wide and relatively shallow for approximately 400 feet. The channel is approximately 50 feet wide and is lined with alluvial gravel and rock material. Below this point, the channel becomes somewhat more irregular and is lined with trees and brush becoming once again a mountain stream channel.</p> | |
| SLOPES | <p>The left slope along the discharge channel is relatively steep and heavily wooded. In the area immediately below the discharge point of the discharge channel, some erosion of the slope has occurred but large rocks appeared to have been placed in there to check the erosion. The problem does not appear to pose a threat to the spillway. The right slope of the channel is quite flat being the original valley floodplain and is generally wooded and brush covered for a distance of 400 to 500 feet downstream.</p> | |
| APPROXIMATE NO. OF HOMES AND POPULATION | <p>At least 20 homes lie on the Cold Stream floodplain in the first 1.5 miles below the dam. The first 4000 feet are uninhabited, densely wooded and contain a former impoundment which was breached during Hurricane Agnes in 1972.</p> | |



| | | | | |
|------------------|---------|--|--|------------------------------------|
| DATE: SEPT. 1980 | | UPPER DAM | | FIELD PROFILE AND SECTION |
| SCALE: AS SHOWN | | NATIONAL DAM INSPECTION PROGRAM | | |
| DR: JF | CK: JEB | ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS | | |
| | | GEO SYSTEMS, INC. 1000 BANKSVILLE RD/PITTSBURGH, PA 15210 | | |

APPENDIX B
ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Upper Dam
I.D. No. PA 00445

| ITEM | REMARKS |
|------------------|--|
| #Design Drawings | Design drawings by Morris Knowles, Consulting Engineer, Pittsburgh, Pennsylvania (dated Oct. 1916 through January 1920) including: |
| C-1000 | Map of Site, dated 9/30/16, revised 10/24/16 |
| C-1001 | Plan and Profile of Dam, dated 10/23/16, revised 10/24/16 |
| C-1003 | Details of Gate House, dated 10/9/16 and 10/23/16, revised 10/24/16 |
| C-1004 | Miscellaneous Steel Details, dated 10/23/16, revised 10/24/16 |
| C-1010 | Spillway Details, dated 10/23/16, revised 10/24/16. |
| C-1014 | Wasteway Channels - Profiles and Details, dated 10/25/16 |
| C-1014 | Wasteway Channels - Profiles and Details, dated 6/28/19 |
| C-1014 | Wasteway Channels - Profiles and Details, dated 1/17/20 |

| <u>ITEM</u> | <u>REMARKS</u> |
|---------------------------|--|
| ◆Design Drawings (Cont'd) | |
| C-1154 | Dam and Intake Details, dated 12/2/16, revised 9/27/17 |
| C-1154 | Dam and Intake Details, dated 12/2/16, revised 1/17/20 |
| C-1300 | C-1003 revised 9/25/17 |
| C-1300 | C-1003 revised 1/17/20 |
| C-2951 | C-1001 revised 9/23/17 |
| C-2591 | C-1001 revised 1/17/20 |
| C-2591 | C-1001 revised 6/28/19 |
| C-2592 | C-1014 Revised, dated 9/24/17 |
| C-4270 | Spillway Sections, dated 6/28/19 |
| C-4270 | Spillway Sections revised 1/17/20 |
| C14282 | Repairs to Reservoir Apron, dated 10/6/43 |
| ◆◆◆Design Drawings | |
| | Design drawings by the American Water Works, Service Company, Inc. Pittsburgh, Pennsylvania including: |
| 203-24 | Field Elevations and Locations of Underwater Pipes, dated 2/27/74. |
| 203-26-1 | Stillling Basin Plans, Section 5 and Detail, dated 6/20/77. |

| ITEM | REMARKS |
|--|---|
| *Design Drawings (Cont'd) | 203-26-1A Stilling Basin Plans, Section 5 and Detail, undated. |
| | 203-26-2 Intake Repairs Plan and Section, dated 6/20/77 |
| As-Built Drawings | None available. |
| Regional Vicinity Map | U.S.G.S. 7-1/2 Minute Sandy Ridge, Pennsylvania Quadrangle Map. |
| *Construction History | Construction began February 1917; halted from about April 1918 to about May 1919 due to finances of owner; completed in April 1921. Periodic progress reports available in PennDER files by owner's engineer and state personnel. See Construction Reports below. |
| *Typical Sections of Dam | Longitudinal and transverse sections, see Design Drawings. |
| *Outlets-Plan Details Constraints Discharge Ratings | See Design Drawings. |
| *Rain/Reservoir Records | Correspondence dated 22 April 1936 to Water and Power Resources Board in response to request for information on March 1936 flood. Data included maximum pool rise of 4.5 feet, rainfall duration not reported, 20 inch blow-off valve open. |

| ITEM | REMARKS |
|--|---|
| *Design Reports | <p>"Report upon the Application of the Citizens Water Service Company of Philipsburg", dated 5 December 1916, prepared by the Division Engineer for the Water and Power Resources Board.</p> <p>"Report Upon the Supplementary Application of the Citizens Water Company of Philipsburg", dated 10 November 1917 prepared by the Assistant Engineer for the Water and Power Resources Board.</p> <p>"Report Upon the Request of the Citizens Water Company (of Philipsburg)" for the approval of revised plans and a time extension, dated 17 March 1920.</p> |
| Geology Reports | None available. |
| Design Computations | None available. |
| Hydrology and Hydraulics | None available. |
| Dam Stability | None available. |
| Seepage Studies | None available. |
| *Materials Investigations, Borings Records, Laboratory, Field | <p>Three test pits dug in the downstream area, See Design Drawing C-1000</p> <p>Foundation soil permeability test reported in State Progress Report dated 14 August 1917.</p> |
| *Post-Construction Surveys of Dam | See Design Drawings 203-24. |

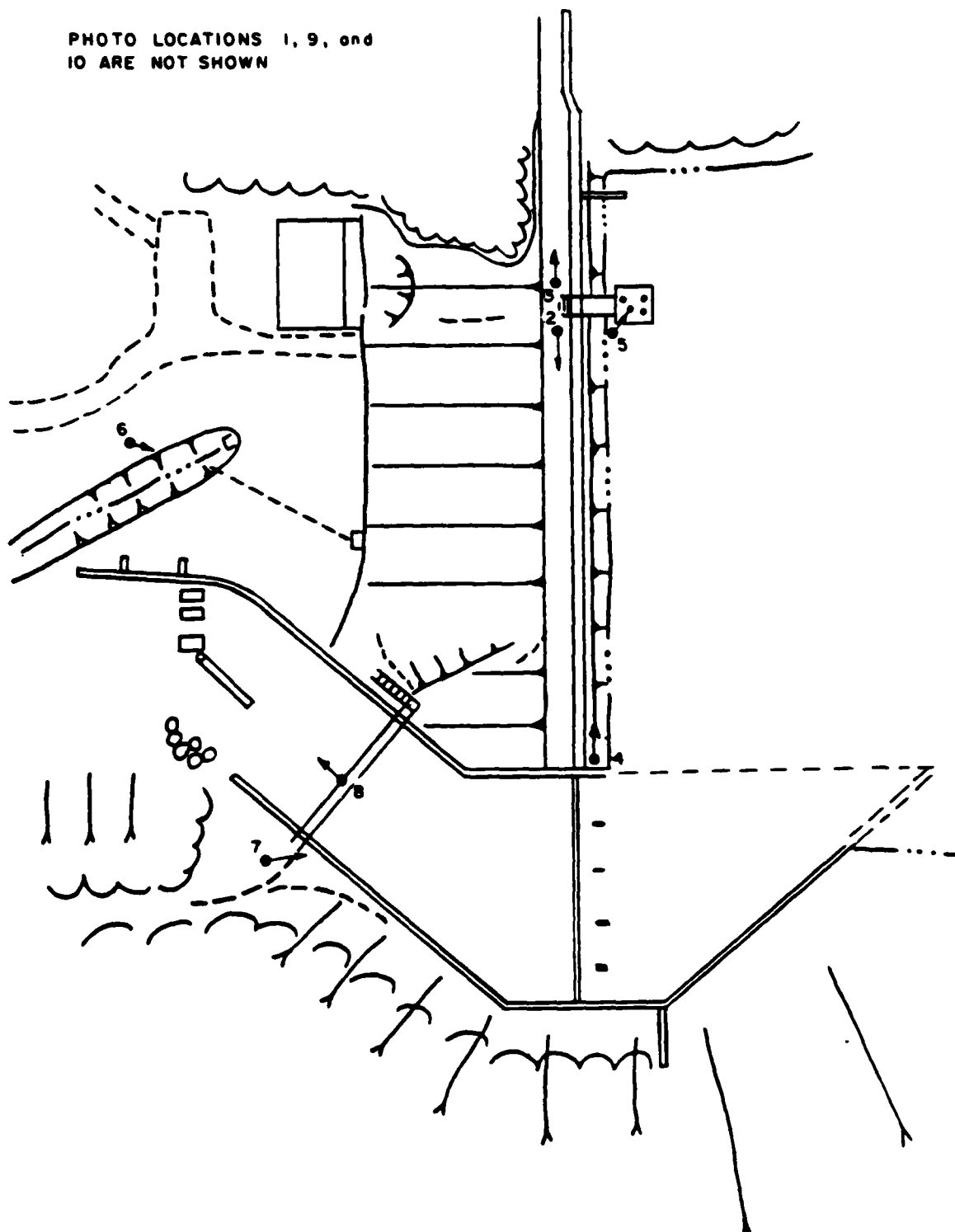
| ITEM | REMARKS |
|---|--|
| *Borrow Sources | On site. |
| Monitoring Systems | None reported. |
| *Modifications | <p>In 1931, a piping condition was observed in the embankment. The condition appears to have developed after the pond drain "blow-off" was sealed. The "blow-off" was opened and repairs made.</p> <p>In 1944, repairs were made to the concrete apron on the upstream slope. These included modifying the joint between the concrete core wall and apron to allow for expansion.</p> <p>In 1977, extensive modifications were made to the gatehouse and spillway. These included: (1) Energy dissipator blocks and walls at the toe of the spillway, (2) New slide gates and valves at gate house, (3) New stairs, fence and gate at gate house.</p> |
| *High Pool Records | See Rainfall/Reservoir Records above. |
| Post-Construction Engineering Studies and Reports | None available. |
| Maintenance, Operation, Records | None available. |
| *Spillway Plan Sections Details | See Design Drawings above. |

| ITEM | REMARKS |
|--|---|
| *Operating Equipment Plans and Details | See Design Drawings above. |
| *Specifications | "Contract and Specifications for Impounding Reservoir" dated 1916. Specifications for Repairs to Reservoir Apron" undated. |
| *Miscellaneous | Miscellaneous correspondence involving application requirements and approval conditions including: Application of the Citizens Water Company of Philipsburg, Pennsylvania dated 16 October 1916 for a permit to construct a dam across Cold Stream Creek, Centre County, Pennsylvania and subsequent Permit to construct a dam dated 20 December 1916. Application of the Citizens Water Company of Philipsburg, Pennsylvania dated 22 October 1917 to extend the date of completion, and a Permit approving the extension dated 13 November 1917. Application of the Citizens Water Company of Philipsburg, Pennsylvania dated 19 July 1919 to change plans approved 20 December 1916. No permit issued. Application of the Citizens Water Company of Philipsburg dated 4 March 1920 to make changes in the plans approved 20 December 1916 and Permit approving the changes, undated. |

| ITEM | REMARKS |
|--|--|
| *Miscellaneous (Cont'd) | <p>Miscellaneous correspondence related to dam inspections of Upper Dam by the Water and Power Resources Board personnel dated 30 July 1925 through 25 May 1961 and one report on dam conducted by Owner dated May 1924.</p> <p>Miscellaneous correspondence relating to spillway capacity and drainage area size, 26 August 1919.</p> |
| Construction Reports | <p>Six Progress Reports upon the Dam of the Citizens Water company of Philipsburg dated between 1 August 1917 and 5 June 1920 by Water Supply Commission Assistant Engineer.</p> <p>Final Report, dated 2 June 1921.</p> <p>Twelve Semi-Monthly Progress Reports Upon the Construction or Repair of Dams, dated between 30 June 1917 and 30 June 1919 by Morris Knowles, Consulting Engineers.</p> |
| Prior Accidents or Failure of Dam Description Reports | See *Modifications above, 1931. |
| <p>*Information and data may be obtained from the PennDER, Harrisburg, Pennsylvania</p> <p>**Reduced size reproductions contained in Appendix E.</p> <p>***Drawings provided by Keystone Water Company, Owner.</p> | |

APPENDIX C
PHOTOGRAPHS

PHOTO LOCATIONS 1, 9, and
10 ARE NOT SHOWN



DATE: SEPT. 1980

SCALE: NONE

DR: AP CK: JEB

UPPER DAM
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING
ENGINEERS
GEO SYSTEMS, INC.
1000 BANKSVILLE RD./PITTSBURGH, PA 15216

PHOTO
KEY
MAP

UPPER DAM



Photo 1 Aerial View of dam and reservoir.



Photo 2 Dam Crest looking toward principal (and emergency) spillway at left abutment.

UPPER DAM

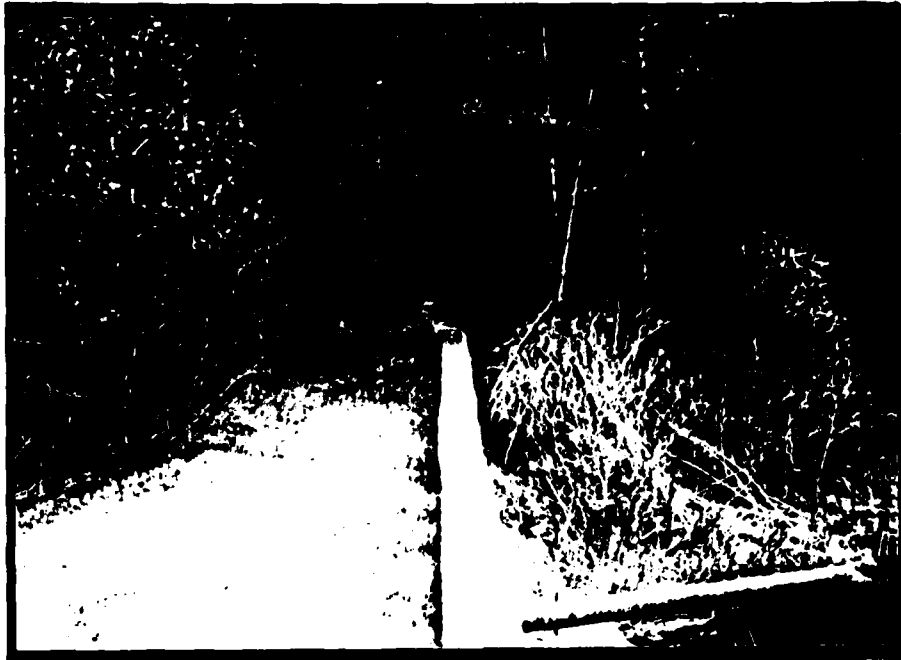


Photo 3 Dam Crest looking toward right abutment.
Pipe (transite) in foreground is augmentation well discharge pipe.

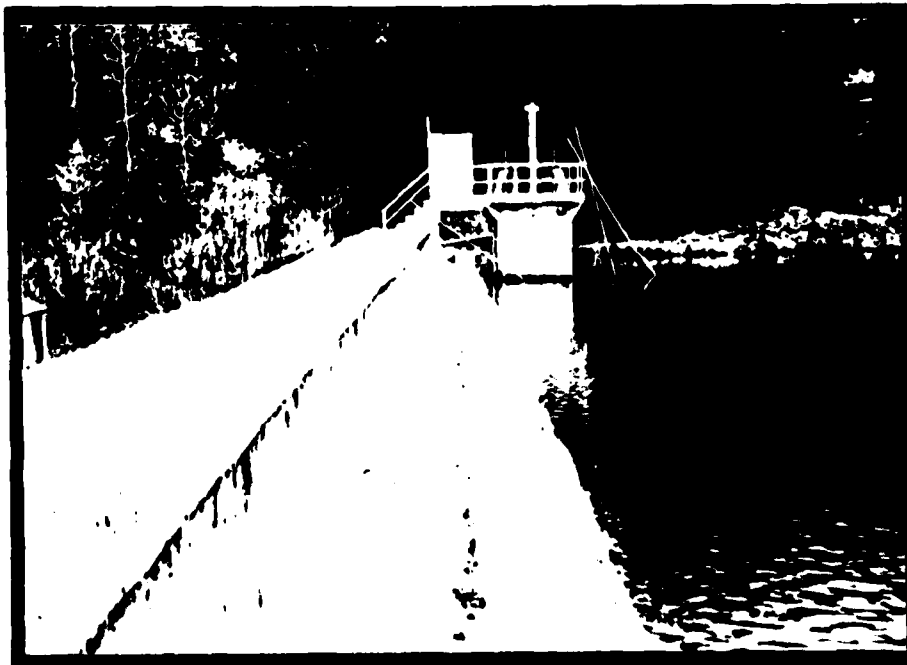


Photo 4 Upstream Slope showing gate house,
parapet wall and upstream slope protection.

UPPER DAM

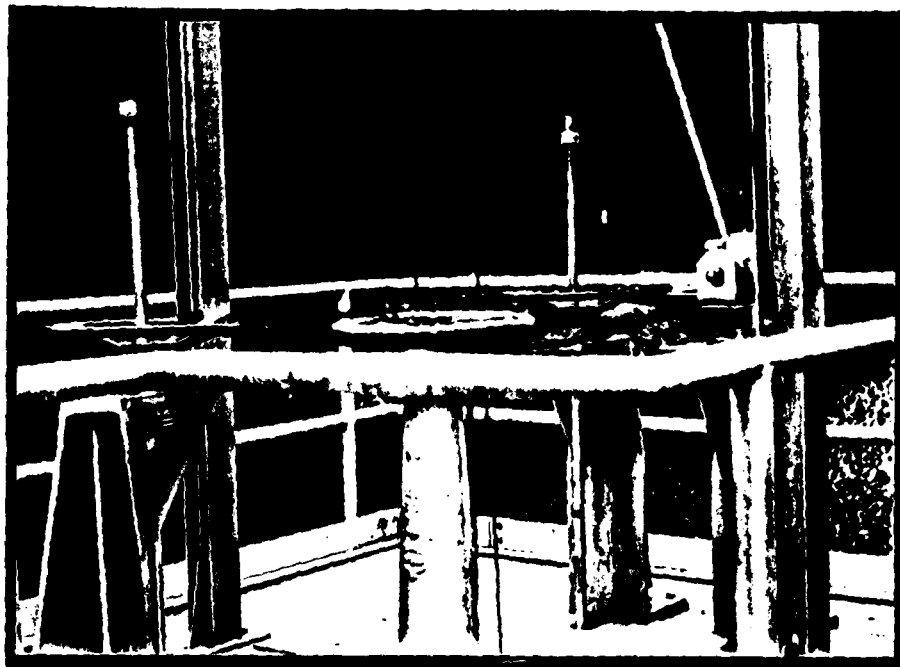


Photo 5 Valve Controls atop gate house.



Photo 6 Pond Drain outlet. Note discharge in spite of closed valve. Also, note spring collection pipe and discharge at far right of picture.

UPPER DAM

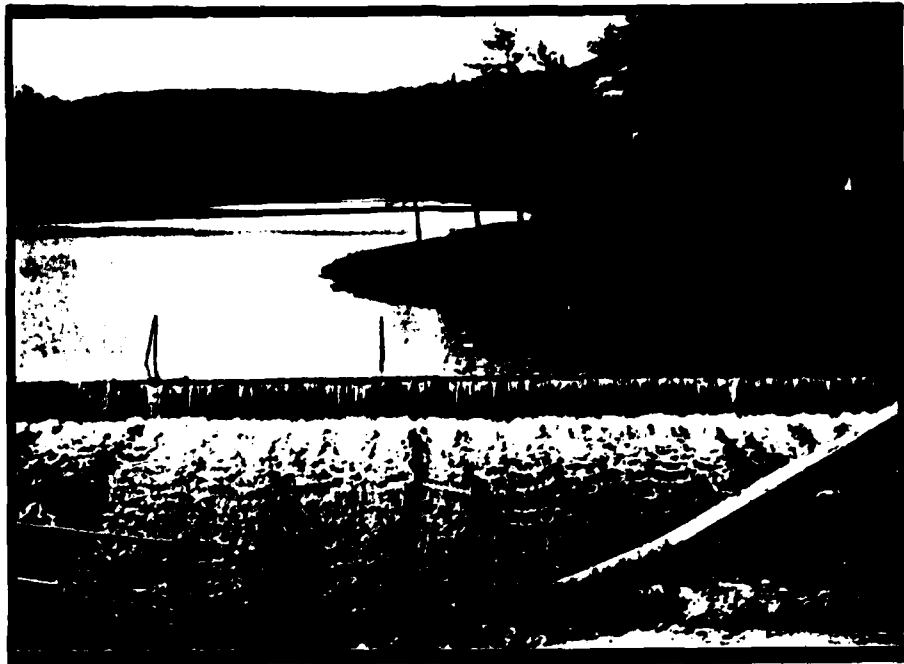


Photo 7 Principal (and Emergency) Spillway Crest.
Note flashboards and bent bar trash
carriers.



Photo 8 Principal (and Emergency) Spillway
"wasteway" channel. Note new training
wall (on right) and original tilted
training wall (on left).

UPPER DAM



Photo 9 Downstream Impoundment breached in June 1972 and not rebuilt.



Photo 10 Downstream Hazards. Inhabited dwellings located on Cold Stream floodplain approximately 2000 feet below Upper Dam.

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

| <u>Parameter</u> | <u>Definition</u> | <u>Where Obtained</u> |
|------------------|--|--|
| Ct | Coefficient representing variations of watershed | From Corps of Engineers |
| L | Length of main stream channel | From U.S.G.S. 7.5 minute topographic map |
| Lca | Length on main stream to centroid of watershed | From U.S.G.S. 7.5 minute topographic map |

| | | |
|----|---------------------|--|
| Cp | Peaking coefficient | From Corps of Engineers* |
| A | Watershed size | From U.S.G.S. 7.5 minute topographic map |

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimeted from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Elevations: The elevations shown on the Field Profile and Section and used in the routing and overtopping analyses are based on U.S.G.S. topographic conditions. Design drawings supplied by PennDER and the Owner show a spillway crest elevation of 1621. However, the U.S.G.S. Sandy Ridge quadrangle (Photo Revised 1971) shows the reservoir pool to be well below the 1620 contour. Consequently, a spillway crest elevation of 1611 was assumed as a benchmark for field survey data and subsequent analyses.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately wooded, no
significant development noted.

ELEVATION TOP NORMAL POOL (STORAGE
CAPACITY): 1611.0 (without flashboards) (80 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE
CAPACITY): 1619.4 (average) (177 acre-feet.)

ELEVATION MAXIMUM DESIGN POOL: 1619.75

ELEVATION TOP DAM: 1619.4 (average) 1619.2 (minimum)

OVERFLOW SECTION

- a. Elevation 1611.0 (1613.1)
- b. Type Open channel (with flashboards)
- c. Width N/A
- d. Length 54.5 feet
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS

- a. Type 16 inch outlet pipe (water supply pipe)
- b. Location Right of centerline
- c. Entrance Inverts (at gate house) 1601, 1609.5
- d. Exit Inverts None
- e. Emergency Drawdown Facilities 20 inch outlet pipe
(pond drain) at gate house

HYDROMETEOROLOGICAL GAGES

- a. Type None
- b. Location N/A
- c. Records None

MAXIMUM REPORTED NON-DAMAGING
DISCHARGE Pool rise 4.5 feet, March 1936

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

| | | | |
|---|-----------|----------------|----------------|
| NAME OF DAM: | Upper Dam | NDI ID NO. | PA 445 |
| Probable Maximum Precipitation (PMP) | | | 22.2* |
| Drainage Area | | | 9.6 sq. mi. |
| Reduction of PMP Rainfall for Data Fit | | 0.8 (22.2) | |
| Reduce by 20%, therefore PMP rainfall = | | =17.8 inches | |
| Geographical Adjustment | | 17.8(1.035) = | 18.4 inch |
| Factor = | 1.035 | | |
| Adjustments of PMF for Drainage Area | | | |
| 6 hrs. | | | 118.5% |
| 12 hrs. | | | 127.5% |
| 24 hrs. | | | 137.0% |
| 48 hrs. | | | 143.0% |
| 72 hrs. | | | 145.5% |
| Snyder Unit Hydrograph Parameters | | | |
| Zone | | | 20** |
| C _p | | | 0.4 |
| C _t | | | 2.1 |
| L | | | 5.8 mile |
| L _{ca} | | | 3.0 mile |
| t _p = C _t (L + L _{ca}) ^{0.3} = | | | 4.95 hours |
| Loss Rates | | | |
| Initial Loss | | | 1.0 inch |
| Constant Loss Rate | | | 0.05 inch/hour |
| Base Flow Generation Parameters | | | |
| Flow at Start of Storm | | 1.5 cfs/sq.mi= | 14.4 cfs |
| Base Flow Cutoff | | 0.05 x Q peak | |
| Recession Ratio | | | 2.0 |
| Overflow Section Data | | | |
| Crest Length | | | 54.5 feet |
| Freeboard | | | 8.2 feet |
| Discharge Coefficient | | | 3.09 |
| Exponent | | | 1.5 |
| Discharge Capacity | | | 4087 cfs |

-
- * Hydrometeorological Report 40
 ** Hydrological zone defined by Corps of Engineers,
 Baltimore District, for determining Snyder's Coefficients
 (C_p and C_t).

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1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Sheet _____ of _____
Job Upper Dam Job No. 79153X
Subject DATA Input
Made By JPH Date 6/12/80 Checked _____ Date _____

LOSS RATE AND BASE FLOW PARAMETERS

As Recommended by Corps of Engineers, Baltimore District

STRTL = 1 inch
CNSTL = 0.05 "/hour
STRTRQ = 1.5 cfs/mi²
QRC SN = 0.05 (5% of Peak Flow)
RTIOR = 2.0

Elevation - Area - Capacity Relationships

From PENNDER LIES, 7.5 min Quad, AND field inspection data

AT Spillway Crest Elevation 1611.0

Initial Storage = 80 Acre-Feet

Pond Surface Area = 10 Acres

At elevation 1620 Area = 12 acres

At elevation 1640 Area = 48 acres

From Conic Method of Reservoir Volume

FLOOD Hydrograph Package (HEC-1)

DAM Safety Version (USERS MANUAL)

$$H = 3V/A = 3(80)/10 = 24 \text{ feet}$$

Elevation where Area Equals Zero:

$$1611 - 24 = 1587.0$$

| AREA | DA | 0.0 | 10.0 | 12.0 | 48 |
|-----------|----|--------|--------|--------|--------|
| ELEVATION | SE | 1587.0 | 1611.0 | 1620.0 | 1640.0 |

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Job Upper Dam Job No. 79153X
Subject Data Input
Made By JPH Date 6/22/80 Checked _____ Date _____

Spillway Parameters

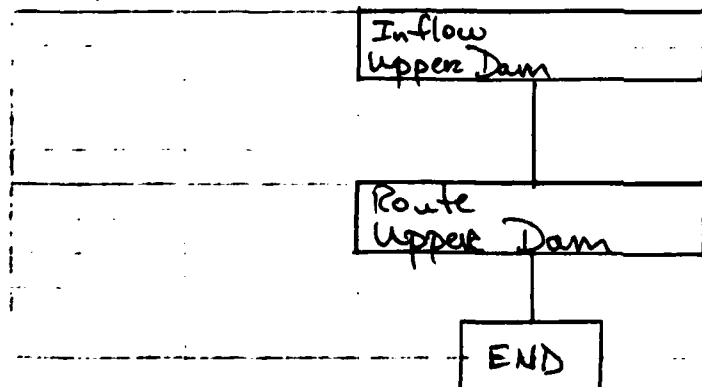
Crest elevation 1611.0
Length of crest 54.5 feet
Coefficient of Discharge 3.09
Flash board Elevation 1613.1

NOTE: It is assumed that the flash boards would fail with a few feet of head over them. Therefore, discharges will be governed by a critical control section at the location of the removed flash boards.

Overtop Parameters

Top of Dam elevation 1619.4 (Average)
Length of Dam (excluding spillway) 257 feet
Coefficient of Discharge "C" 3.09

Program Schedule



 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

| | | | | | | | | | | | |
|----|------|---|-------|-------|-------|-----|-----|-------|-----|---|-----|
| 1 | A1 | NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS | | | | | | | | | |
| 2 | A2 | HYDROLOGIC AND HYDRAULIC ANALYSIS OF UPPER DAM-COLD STREAM | | | | | | | | | |
| 3 | A3 | PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD | | | | | | | | | |
| 4 | B | 300 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 0 | -4 |
| 5 | B1 | 5 | | | | | | | | | |
| 6 | J | 1 | 3 | 1 | | | | | | | |
| 7 | J1 | 1. | .5 | .4 | | | | | | | |
| 8 | K | 0 | 1 | | | | | | | | 1 |
| 9 | K1 | INFLOW HYDROGRAPH FOR UPPER DAM - COLD STREAM | | | | | | | | | |
| 10 | M | 1 | 1 | 9.6 | 9.6 | | | | | | 1 |
| 11 | P | | 23.0 | 118.5 | 127.5 | 137 | 143 | 145.5 | | | |
| 12 | T | | | | | | | 1.0 | .05 | | |
| 13 | W | 4.95 | 0.40 | | | | | | | | |
| 14 | X | -1.5 | -0.05 | 2.0 | | | | | | | |
| 15 | K | 1 | 2 | | | | | | | | 1 |
| 16 | K1 | ROUTING AT UPPER DAM - COLD STREAM | | | | | | | | | |
| 17 | Y | | | | 1 | 1 | | | | | |
| 18 | Y1 | 1 | | | | | | | | | 80. |
| 19 | \$A | 0. | 10. | 12. | 48. | | | | | | |
| 20 | \$E | 1587. | 1611. | 1620. | 1640. | | | | | | |
| 21 | \$\$ | 1611.0 | 54.5 | 3.08 | 1.5 | | | | | | |
| 22 | \$D | 1619.4 | 3.08 | 1.5 | 257. | | | | | | |
| 23 | K | 99 | | | | | | | | | |
| 24 | A | | | | | | | | | | |
| 25 | A | | | | | | | | | | |
| 26 | A | | | | | | | | | | |
| 27 | A | | | | | | | | | | |
| 28 | A | | | | | | | | | | |

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

| | |
|----------------------|---|
| RUNOFF HYDROGRAPH AT | 1 |
| ROUTE HYDROGRAPH TO | 2 |
| END OF NETWORK | |

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 24 JUN 80
 RUN TIME: 6.35.17

NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF UPPER DAM-COLD STREAM
 PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

| JOB SPECIFICATION | | | | | | | | | |
|-------------------|-----|------|------|-----|-------|-------|------|------|-------|
| NQ | NHR | NMIN | IDAY | IHR | IMIN | METRC | IPLT | IPRT | NSTAN |
| 300 | 0 | 45 | 0 | 0 | 0 | 0 | 0 | 4 | 0 |
| JOPER | | | | NMT | LROPT | TRACE | | | |
| 5 | | | | 0 | 0 | 0 | | | |

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 3 LRTIO= 1
 RTIOS= 1.00 0.50 0.40

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR UPPER DAM - COLD STREAM

| | | | | | | | | |
|-------|-------|-------|-------|------|------|-------|--------|-------|
| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTC |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

| HYDROGRAPH DATA | | | | | | | | | |
|-----------------|------|-------|------|-------|-------|-------|-------|-------|-------|
| IHYDG | IUMG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOW | ISAME | LOCAL |
| 1 | 1 | 9.60 | 0.0 | 9.60 | 0.0 | 0.0 | 0 | 1 | 0 |

| PRECIP DATA | | | | | | | |
|-------------|-------|--------|--------|--------|--------|--------|-----|
| SPFE | PMS | R6 | R12 | R24 | R48 | R72 | R96 |
| 0.0 | 23.00 | 118.50 | 127.50 | 137.00 | 143.00 | 145.50 | 0.0 |

TRSPC COMPUTED BY THE PROGRAM IS 0.800

| LOSS DATA | | | | | | | | | | |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| LROPT | STRKR | DLTKR | RTIOL | ERAIN | STRKS | RTIOK | STRIL | CNSTL | ALSMX | RTIME |
| 0 | 0.0 | 0.0 | 1.00 | 0.0 | 0.0 | 1.00 | 1.00 | 0.05 | 0.0 | 0.0 |

UNIT HYDROGRAPH DATA

TP= 4.95 CP=0.40 NTA= 0

| RECESSION DATA | | |
|----------------|-------|--------------|
| STRTQ= | -1.50 | QRCNS= -0.05 |
| | | RTIOR= 2.00 |

| UNIT HYDROGRAPH 71 END-OF-PERIOD ORDINATES, LAG= 4.98 HOURS, CP= 0.40 VOL= 1.00 | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|
| 25. | 95. | 193. | 305. | 406. | 475. | 500. | 479. | 443. | 409. |
| 377. | 348. | 322. | 297. | 274. | 253. | 234. | 216. | 199. | 184. |
| 170. | 157. | 145. | 134. | 124. | 114. | 105. | 97. | 90. | 83. |
| 77. | 71. | 65. | 60. | 56. | 51. | 48. | 44. | 41. | 37. |
| 35. | 32. | 29. | 27. | 25. | 23. | 21. | 20. | 18. | 17. |
| 16. | 14. | 13. | 12. | 11. | 10. | 10. | 9. | 8. | 6. |
| 7. | 6. | 6. | 6. | 5. | 5. | 4. | 4. | 4. | 3. |
| 3. | | | | | | | | | |

| END-OF-PERIOD FLOW | | | | | | | | | | | | | |
|--------------------|-------|--------|------|------|------|--------|-------|-------|--------|------|------|------|--------|
| MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP Q |

SUM***** 12.23***** 101669.
(*****)(311.)(*****)(2878.95

HYDROGRAPH ROUTING

ROUTING AT UPPER DAM - COLD STREAM

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTC |
|--------------|-------|-------|-------|-------|------|-------|--------|-------|
| 2 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| ROUTING DATA | | | | | | | | |
| QLOSS | CLOSS | AVG | IRES | ISAME | IOPT | IPMP | LSTR | |
| 0.0 | 0.0 | 0.0 | 1 | 1 | 0 | 0 | 0 | |
| NSTPS | NSTD | LAG | AMSKK | X | TSK | STORA | ISPRAT | |
| 1 | 0 | 0 | 0.0 | 0.0 | 0.0 | 80. | 0 | |

SURFACE AREA= 0. 10. 12. 48.
 CAPACITY= 0. 80. 179. 739.
 ELEVATION= 1587. 1611. 1620. 1640.

CREL SPWID COQW EXPW ELEV COOL CAREA EXPL
 1611.0 54.5 3.1 1.5 0.0 0.0 0.0 0.0

DAM DATA
 TOPEL COQD EXPD DAMWID
 1619.4 3.1 1.5 257.

PEAK OUTFLOW IS 4862. AT TIME 43.50 HOURS
 PEAK OUTFLOW IS 2432. AT TIME 44.25 HOURS
 PEAK OUTFLOW IS 1946. AT TIME 44.25 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS | | |
|---------------|----------|-----------|----------|-------------------------|---------|---------|
| | | | | RATIO 1 | RATIO 2 | RATIO 3 |
| | | | | 1.00 | 0.50 | 0.40 |
| HYDROGRAPH AT | 1 | 9.60 | 1 | 4883. | 2441. | 1953. |
| | (24.86) | (138.27) | (69.13) | (55.31) | | |
| ROUTED TO | 2 | 9.60 | 1 | 4862. | 2432. | 1946. |
| | (24.86) | (137.68) | (68.86) | (55.09) | | |

SUMMARY OF DAM SAFETY ANALYSIS

| PLAN 1 | ELEVATION | INITIAL VALUE | SPILLWAY CREST | TOP OF DAM | | | | |
|--------------|----------------------------|------------------------|-----------------------|---------------------|-------------------------|---------------------------|-----------------------|--|
| | 1611.00 | 1611.00 | 1611.00 | 1619.40 | | | | |
| | STORAGE | 80. | 80. | 172. | | | | |
| | OUTFLOW | 0. | 0. | 4087. | | | | |
| RATIO OF PMF | MAXIMUM RESERVOIR W.S.ELEV | MAXIMUM DEPTH OVER DAM | MAXIMUM STORAGE AC-FT | MAXIMUM OUTFLOW CFS | DURATION OVER TOP HOURS | TIME OF MAX OUTFLOW HOURS | TIME OF FAILURE HOURS | |
| 1.00 | 1619.98 | 0.58 | 179. | 4862. | 5.25 | 43.50 | 0.0 | |
| 0.50 | 1616.94 | 0.0 | 143. | 2432. | 0.0 | 44.25 | 0.0 | |
| 0.40 | 1616.12 | 0.0 | 134. | 1946. | 0.0 | 44.25 | 0.0 | |

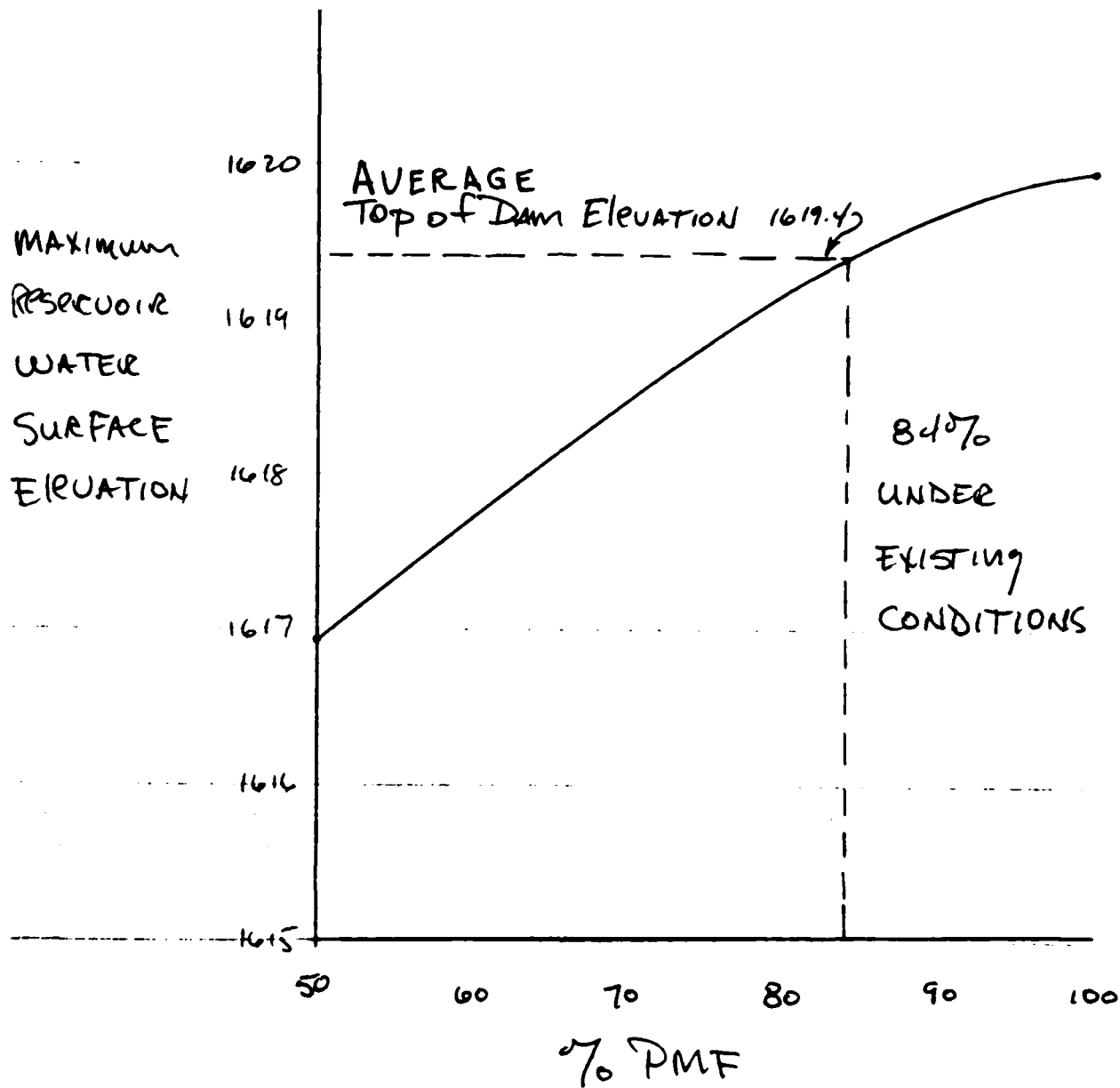
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PITTSBURGH, PA. 15216
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Sheet _____ of _____

Job Upper Dam Job No. 79153X

Subject Hydrologic Performance Plot

Made By JPH Date 6/22/80 Checked _____ Date _____

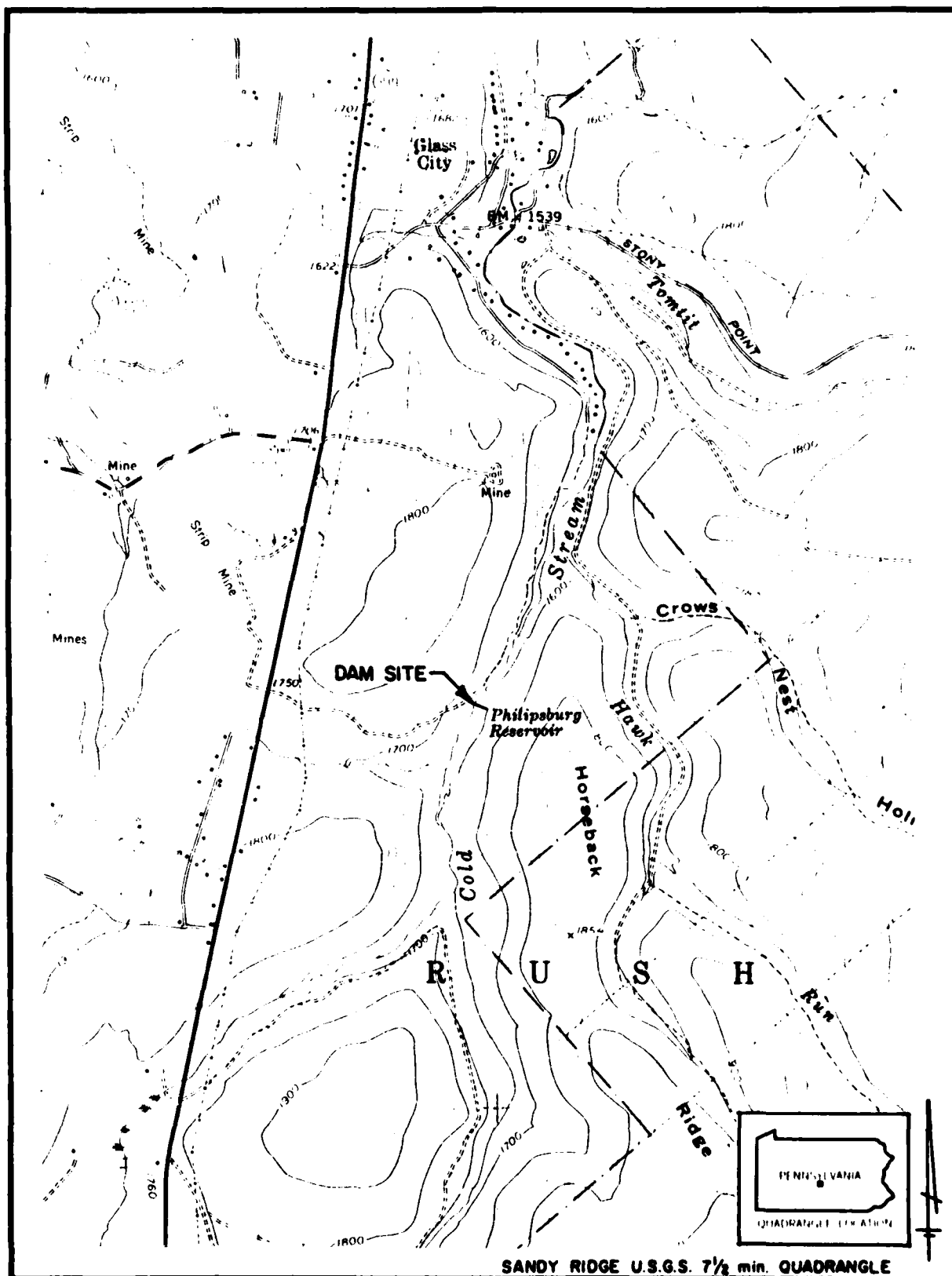


APPENDIX E

PLATES

LIST OF PLATES

- | | |
|------------|---|
| Plate I | Regional Vicinity Map. |
| Plate II | Citizens Water Company of Philipsburg, Pennsylvania, Map of Site. |
| Plate III | Citizens Water Company of Philipsburg, Pennsylvania, Plan and Profile of Dam. |
| Plate IV | Citizens Water Company of Philipsburg, Pennsylvania, Dam and Intake Details. |
| Plate V | Citizens Water Company of Philipsburg, Pennsylvania, Spillway Sections. |
| Plate VI | Citizens Water Company of Philipsburg, Pennsylvania, Wasteway Channels - Profile and Details. |
| Plate VII | Citizens Water Company of Philipsburg, Pennsylvania, Details of Gate House. |
| Plate VIII | Citizens Water Company of Philipsburg, Pennsylvania, Repairs to Reservoir Apron. |
| Plate IX | Field Elevations and Locations of Underwater Intakes; Philipsburg No. 3 Dam. |
| Plate X | Philipsburg Dam No. 3 Improvements, Stilling Basin - Plans, Sections and Detail. |
| Plate XI | Philipsburg Dam No. 3 Improvements, Intake Repairs - Plan and Sections. |



SANDY RIDGE U.S.G.S. 7 1/2 min. QUADRANGLE

DATE: SEPT. 1980

SCALE: 1" = 2000'

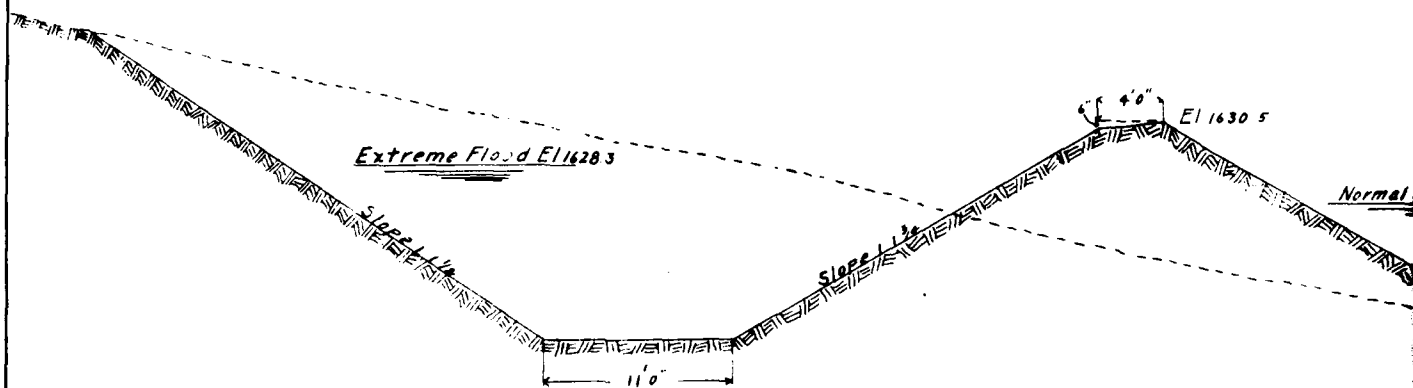
DR: JF CK:

DWG. NO. PLATE I

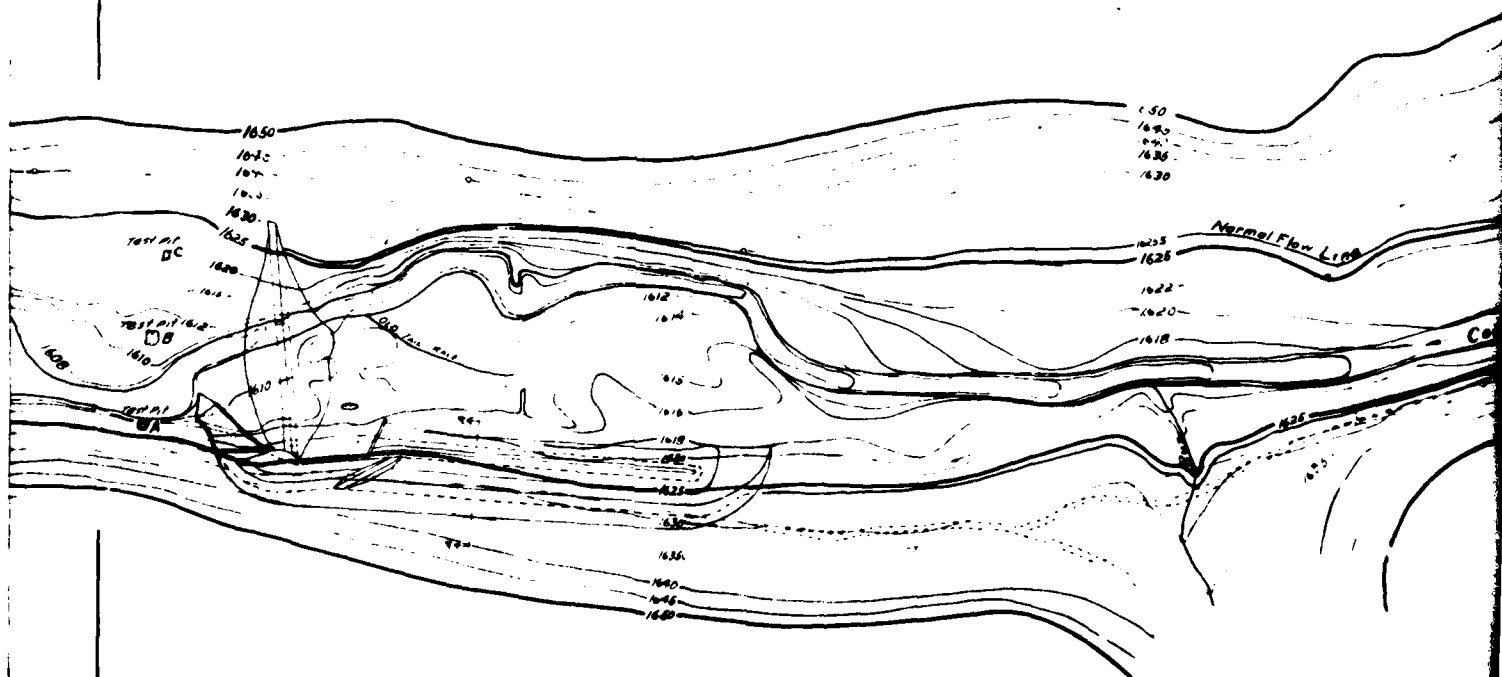
UPPER DAM
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING
GEO SYSTEMS, INC. ENGINEERS
1000 BANKSVILLE RD./PITTSBURGH, PA 15216

REGIONAL
VICINITY
MAP



Typical Section in Earth
By Pass Channel
Scale 1"=5'



Test Pit A

El of ground surface 1618.6

- 0' to 2' Sandy clay top soil
- 2' to 4' Sand and small boulders, small layer of clay intermixed
- 4' to 6' Sand, clay, very hard
- 6' to 8' Sand gravel, small boulders, very hard
- 8' to 10' 2' to 4' of gravel, coarse sand
- 10' to 12' Sand gravel, small boulders
- 12' to 14' Sand gravel, small boulders
- 14' to 16' Sand gravel, small boulders
- 16' to 18' Sandstone boulder

Test Pit C

El of ground surface 1620.2

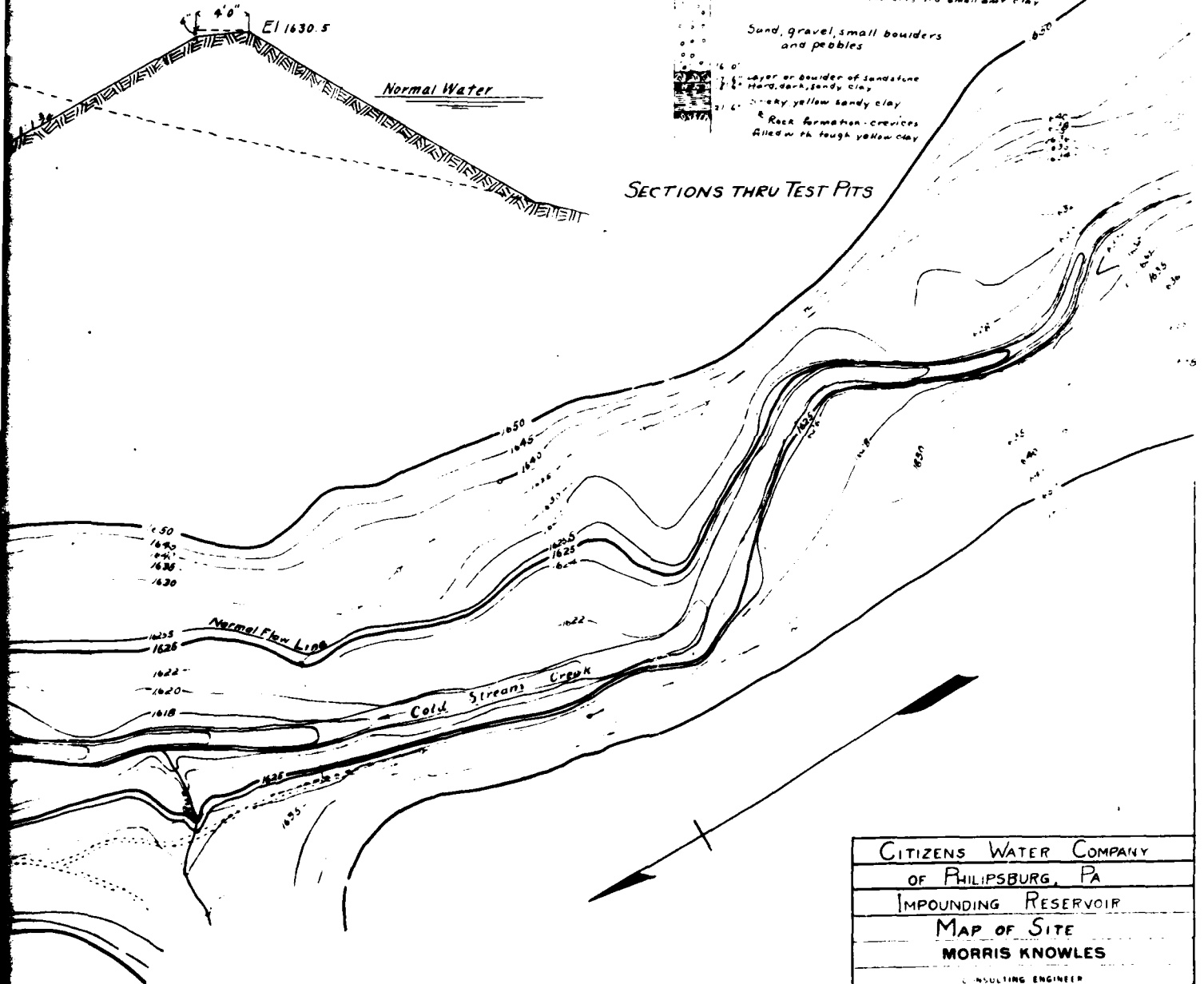
- 0' to 2' Sandy clay top soil
- 2' to 4' Layer of boulder of sandstone
- 4' to 6' Sand gravel, small boulders, and some clay
- 6' to 8' Sand gravel, small boulders, and some clay
- 8' to 10' Sand gravel, small boulders, and some clay
- 10' to 12' Sand gravel, small boulders, and some clay
- 12' to 14' Sand gravel, small boulders, and some clay
- 14' to 16' Sand gravel, small boulders, and some clay
- 16' to 18' Sand gravel, small boulders, and some clay
- 18' to 20' Sand gravel, small boulders, and some clay

Test Pit B

El of ground surface 1611.9

- 0' to 2' sandy clay top soil
- 2' to 4' Layer of boulder of sandstone
- 4' to 6' Sand and small boulders, and small amount clay
- 6' to 8' Sand, gravel, small boulders and pebbles
- 8' to 10' Layer of boulder of sandstone
- 10' to 12' Hard, dark, sandy clay
- 12' to 14' Sticky yellow sandy clay
- 14' to 16' Rock formation crevices filled with tough yellow clay

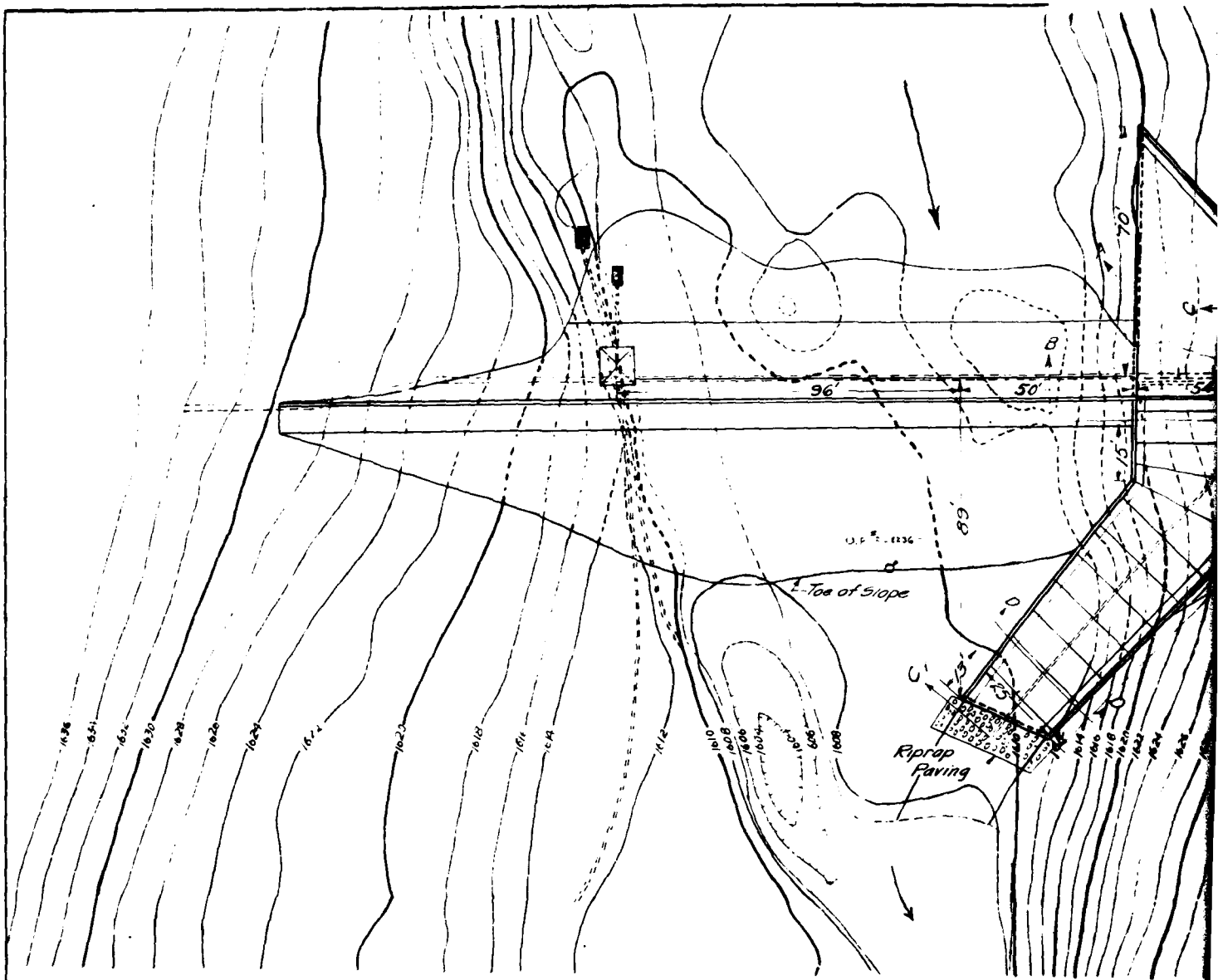
SECTIONS THRU TEST PITS



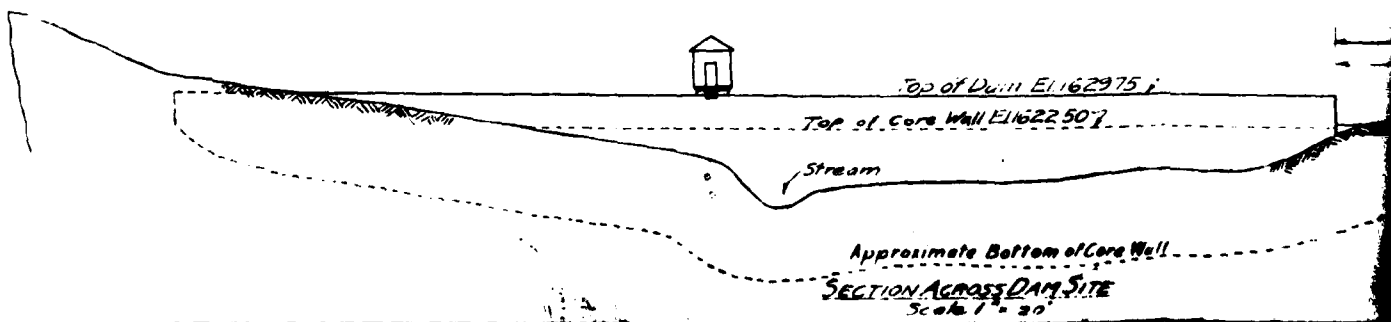
| | | |
|--------------------------|------------------|------|
| CITIZENS WATER COMPANY | | |
| OF PHILIPSBURG, PA | | |
| IMPOUNDING RESERVOIR | | |
| MAP OF SITE | | |
| MORRIS KNOWLES | | |
| CONSULTING ENGINEER | | |
| PITTSBURGH, PA | | |
| CONTOUR INTERVAL 5'-3.2' | | |
| SCALE 100 FT = 1 INCH | | |
| DR. N. A. | REV. OCT 24 1916 | REV. |
| TR. N. A. | REV. | REV. |
| CH. | REV. | REV. |
| C-1000 | | |

PLATE II

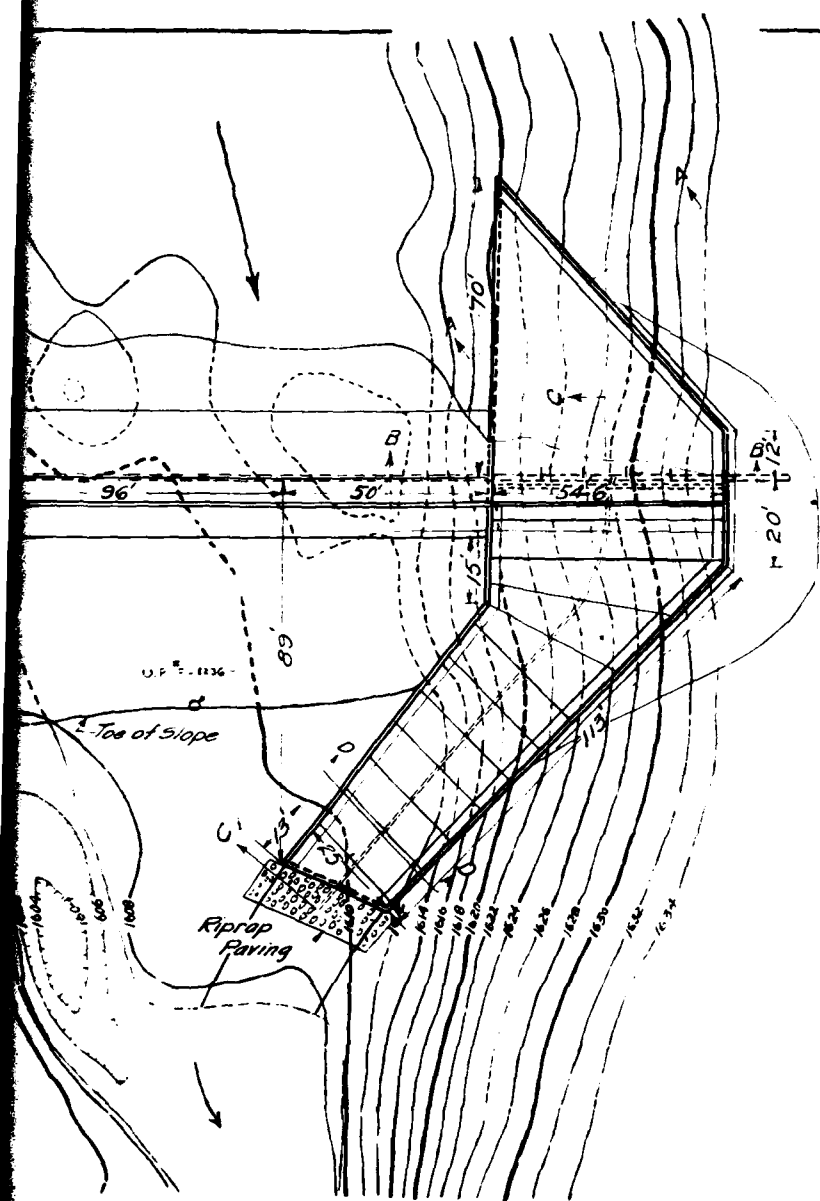
203-12-1



PLAN OF DAM & WASTEWAY
Scale 1" = 20'

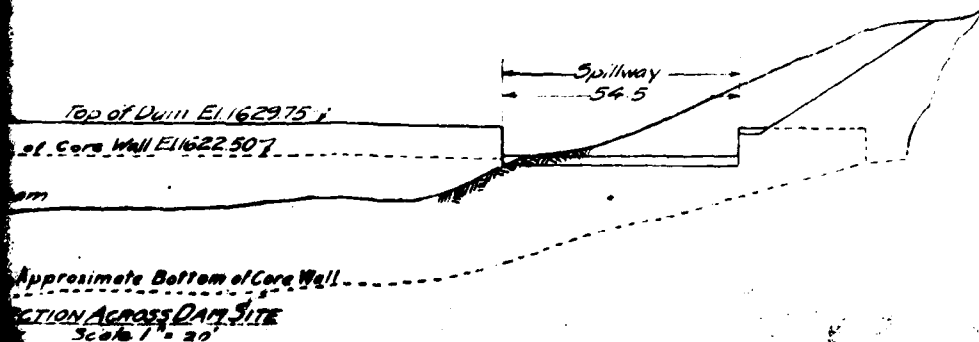


SECTION ACROSS DAM SITE
Scale 1" = 30'



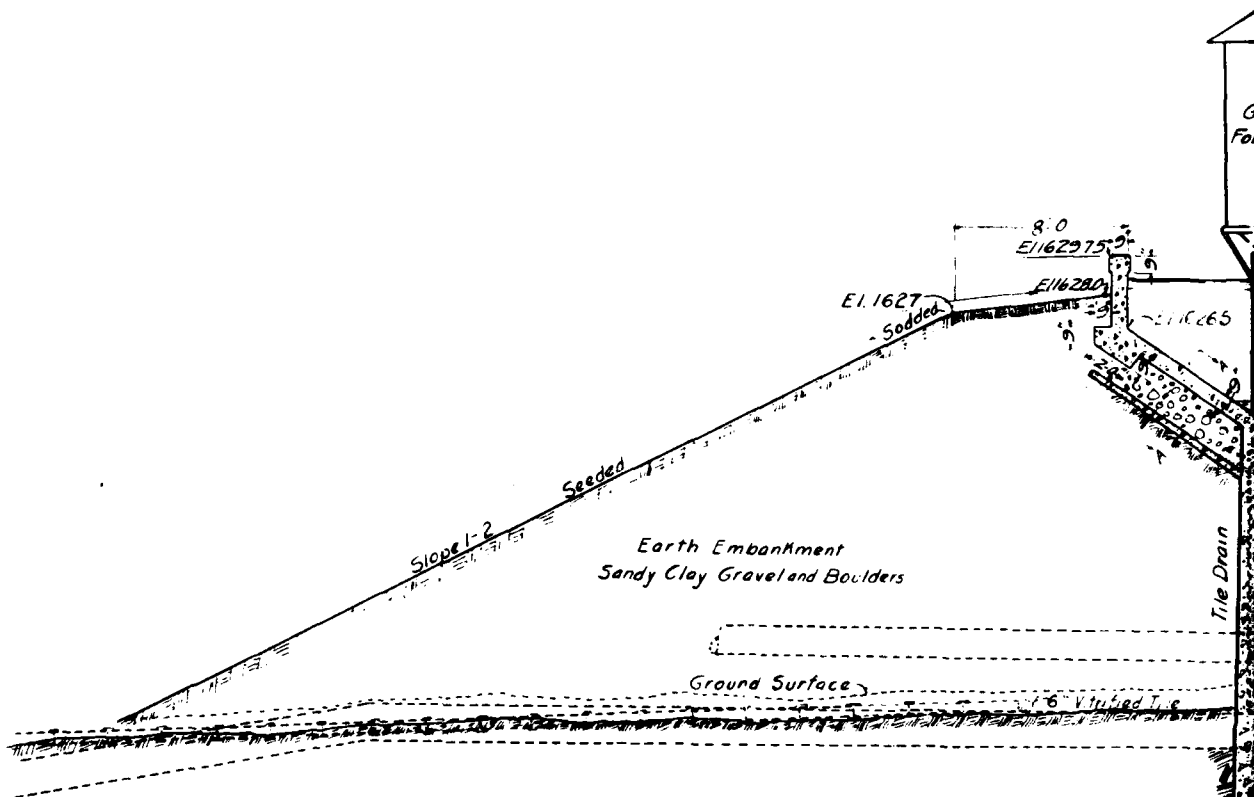
DAM & WASTEWAY
Scale 1" = 20'

Note: For Sections See
Drawings C-4270, C 1014



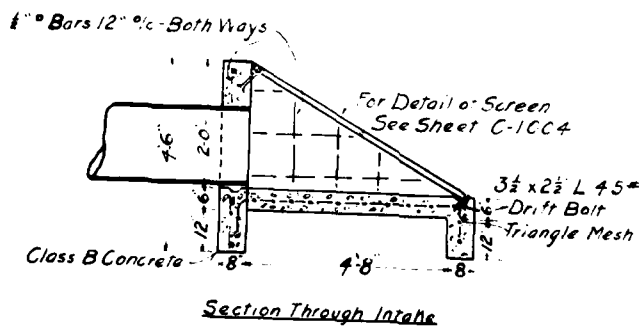
CROSS SECTION ACROSS DAM SITE
Scale 1" = 20'

| | | |
|----------------------------|--------------------|--------------------------|
| CITIZENS WATER COMPANY | | |
| OF PHILIPSBURG, PA. | | |
| IMPOUNDING RESERVOIR | | |
| PLAN AND PROFILE OF DAM | | |
| MORRIS KNOWLES | | |
| REGISTERED ENGINEERS | | |
| PHILADELPHIA, PA. | | |
| SCALE AS INDICATED | OCT 9, 1916 | |
| DR. R. P. H. A. | REV. OCT 20, 1916 | REV. '09 '11 |
| TO R. P. H. A. N. | REV. NOV 12, 1916 | REV. JAN - 1920 J. E. S. |
| CH. | REV. JUNE 26, 1918 | REV. |
| Revised from C-1001 C 2591 | | |

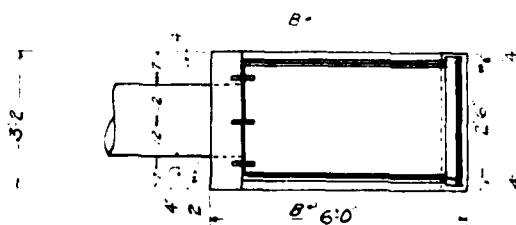


Section AA
TYPICAL PROFILE OF DAM

Scale $\frac{1}{4}'' = 1'$

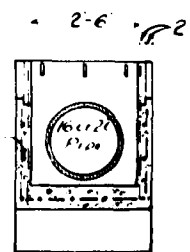


Section Through Intake



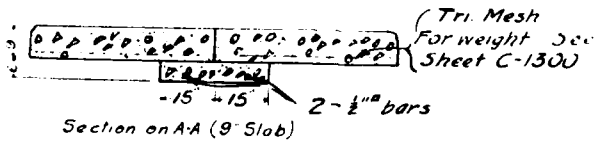
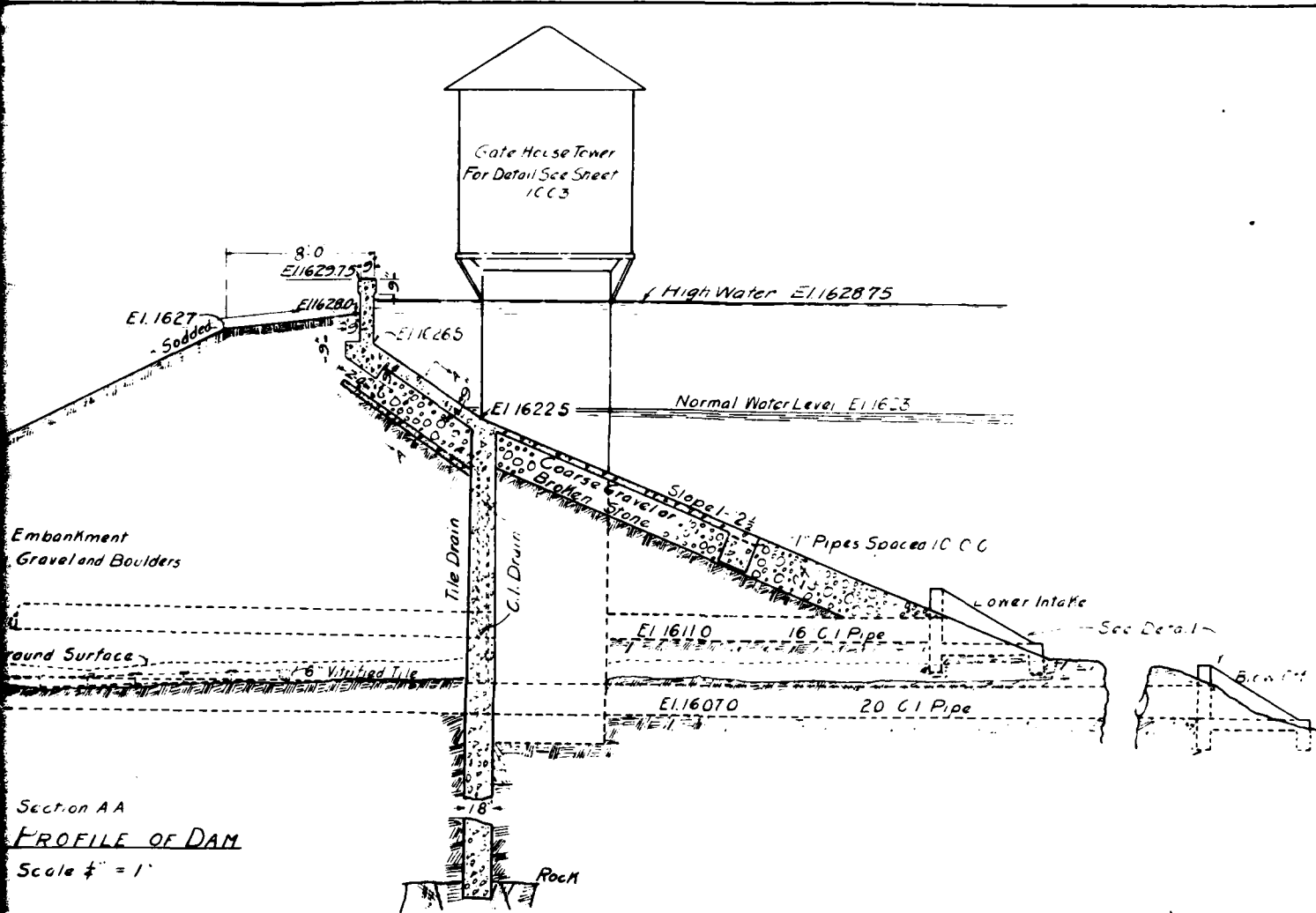
PLAN OF INTAKE
 Scale $\frac{1}{4}'' = 1'$

Two Required

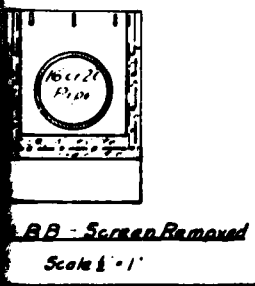


Section BB - Screen Removed

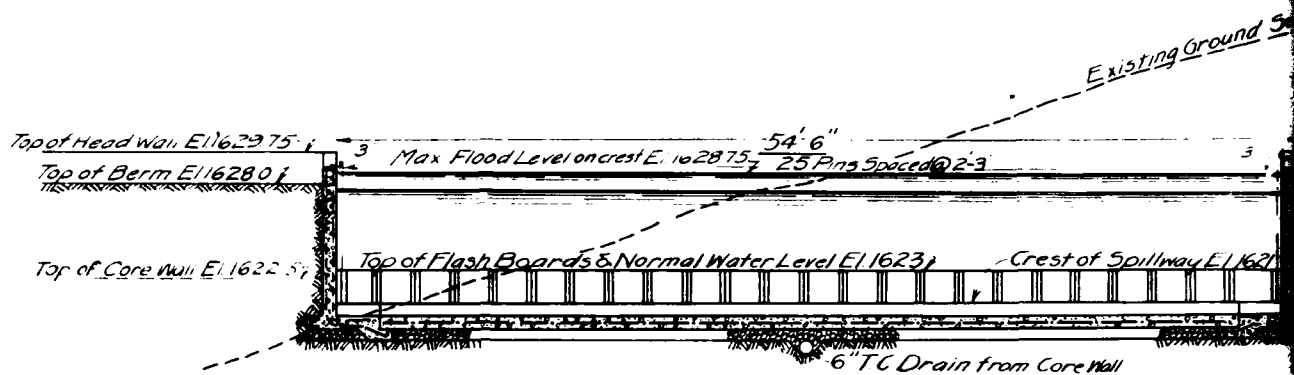
Scale $\frac{1}{4}'' = 1'$



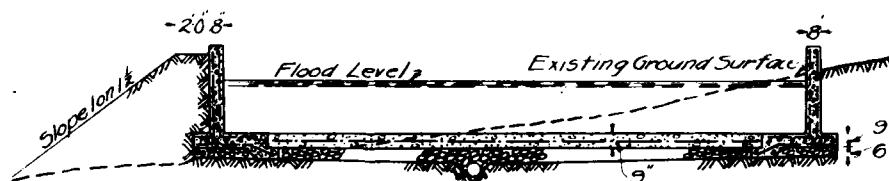
DETAIL OF PAVING SLAB JOINT
Scale 1/4" = 1"
To Be Used Where Required



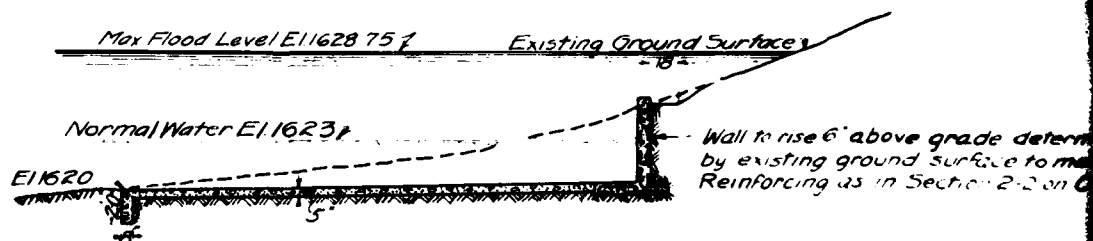
| CITIZENS WATER COMPANY | | | |
|------------------------|-----|--------------------|--------|
| OF PHILIPSBURG, PA. | | | |
| IMPOUNDING RESERVOIR | | | |
| DAM AND INTAKE DETAILS | | | |
| MORRIS KNOWLES | | | |
| INCORPORATED ENGINEERS | | | |
| SCALE AS INDICATED | | DEC 2 - 1918 | |
| DR RDB | HEA | Sep 27, 1917 | REV. |
| TR | HEA | REV. JAN. 17, 1920 | REV. |
| CH | | REV. | REV. |
| Revised from C-1002 | | | C-1154 |



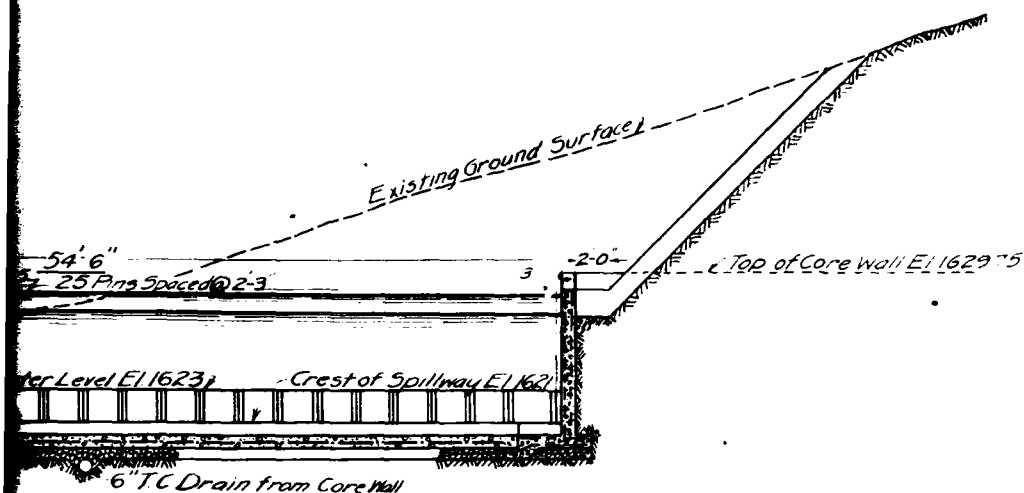
SECTION B-B
 LOOKING UPSTREAM
 Scale 1"=5'-0"



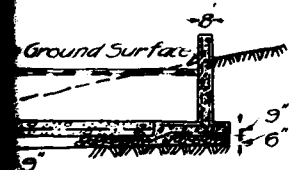
SECTION D-D
 Scale 1"=5'-0"



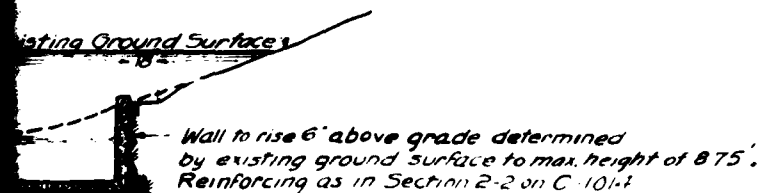
SECTION A-A
 Scale 1"=5'-0"



SECTION B-B
 VIEWING UPSTREAM
 Scale 1"=5'-0"

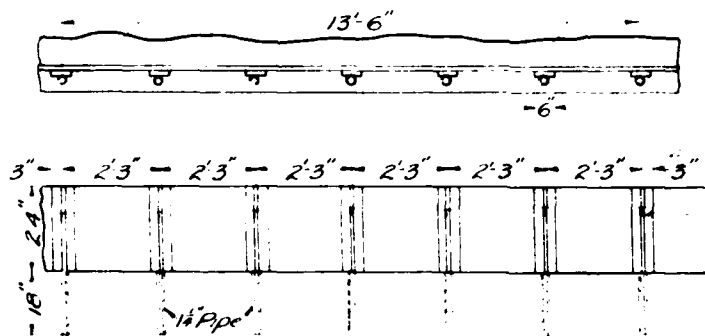
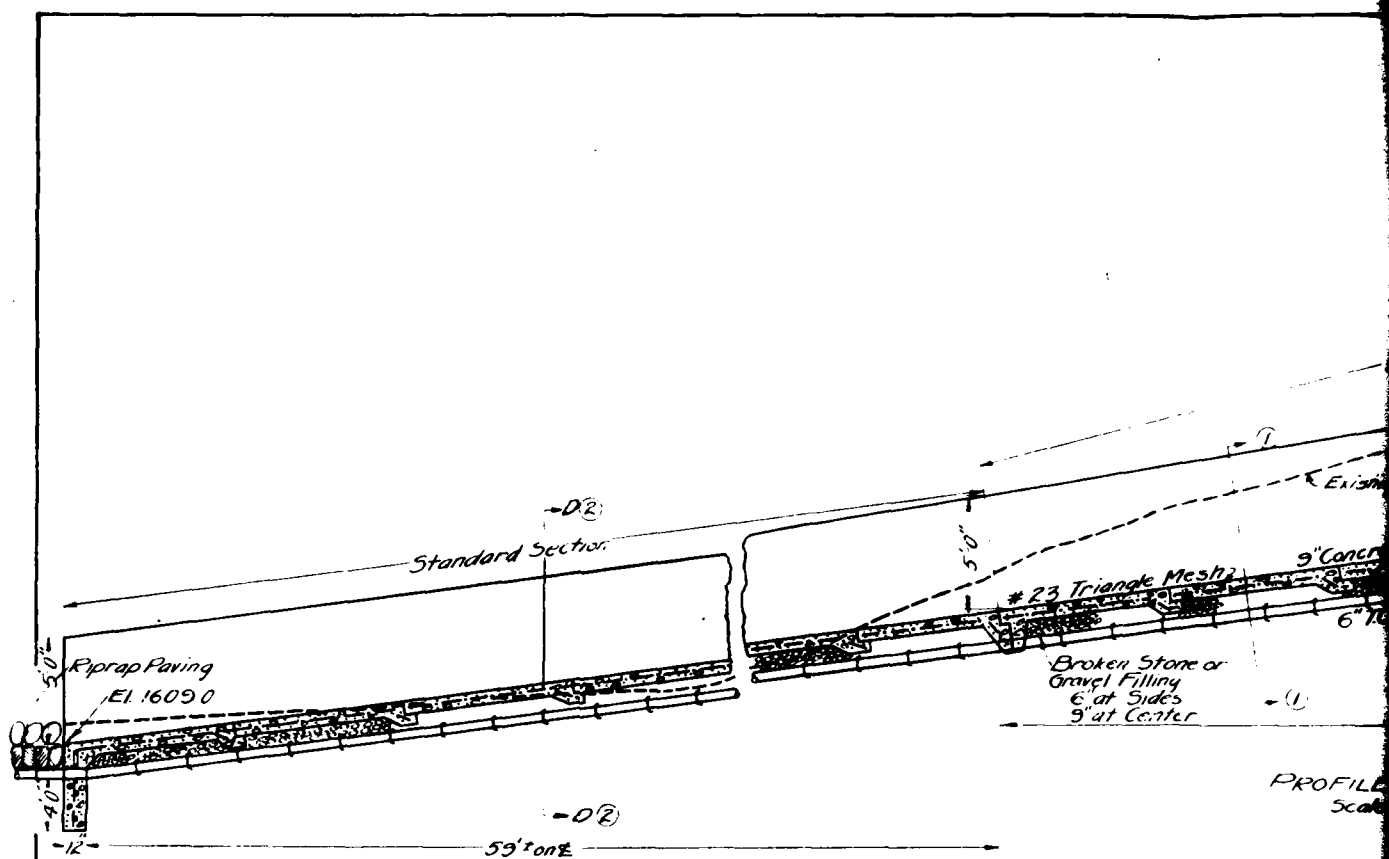


Note: For Plan see C-2591

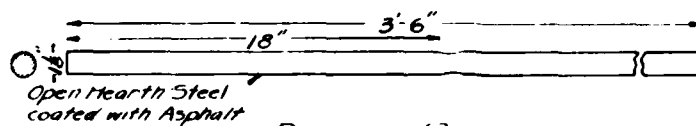


| CITIZENS WATER COMPANY | | | |
|------------------------|--------------------|---------------|--------|
| OF PHILIPSBURG, PA | | | |
| SPILLWAY SECTIONS | | | |
| MORRIS KNOWLES, | | | |
| INCORPORATED | | | |
| ENGINEERS | | | |
| PITTSBURGH, PA. | | | |
| SCALE AS SHOWN | DATE | JUNE 28, 1929 | |
| DR H E A | 1 REV JAN 17, 1920 | 4 REV | |
| TR I D | 2 REV | 5 REV | |
| CH | 3 REV | 6 REV | |
| | | | C-4270 |

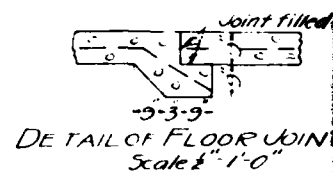
PLATE V 203-12-7



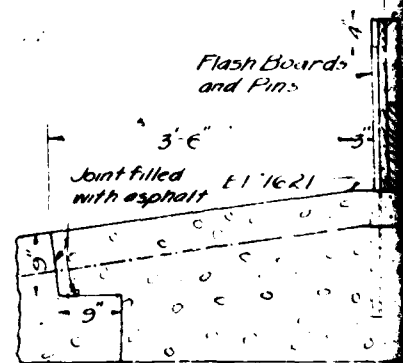
ELEVATION FLASH BOARDS
Scale 1/2" = 1'-0"



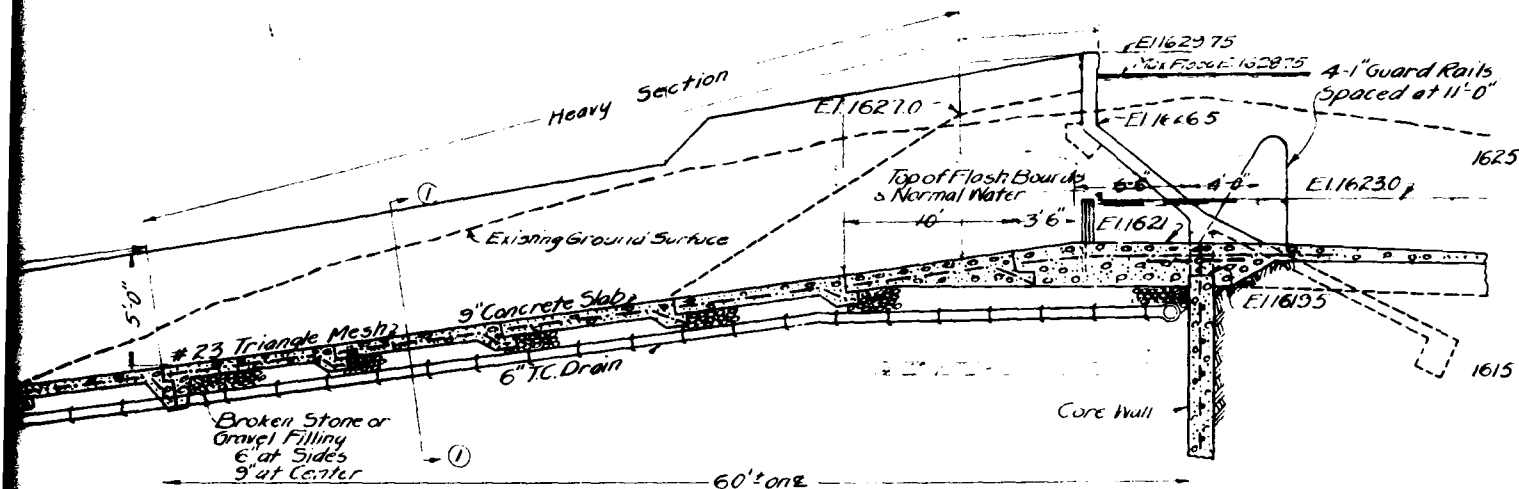
DETAIL OF PIN
Scale 3/4" = 1'-0"



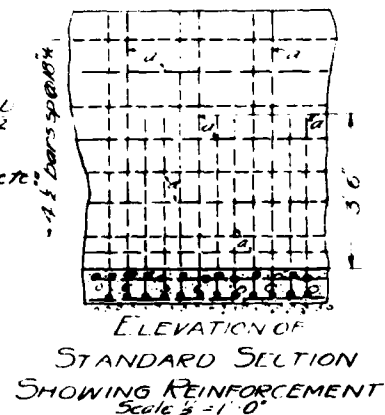
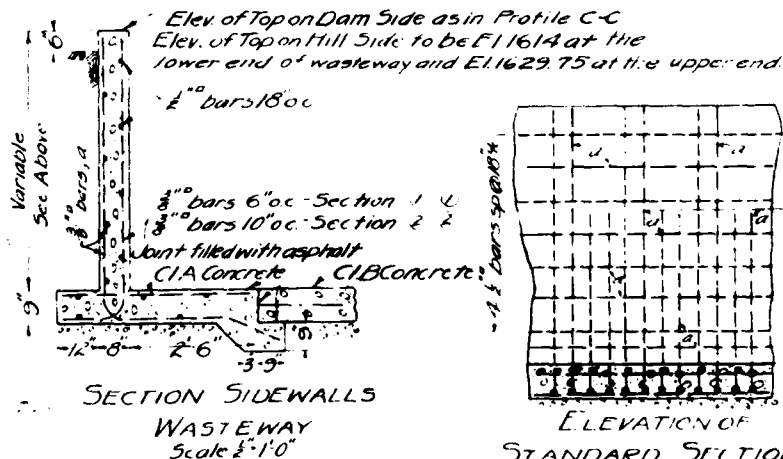
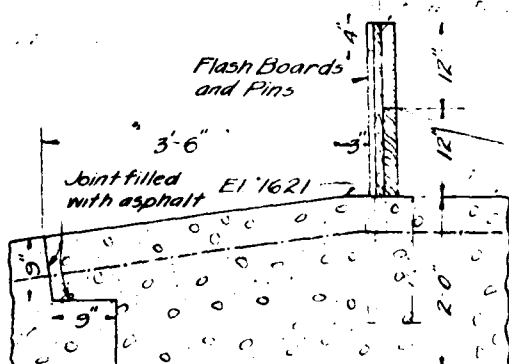
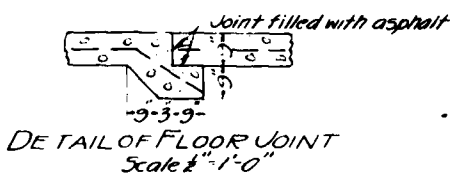
DETAIL OF FLOOR JOINT
Scale 1/2" = 1'-0"



DETAIL OF SPILLWAY
Scale 1" = 1'-0"

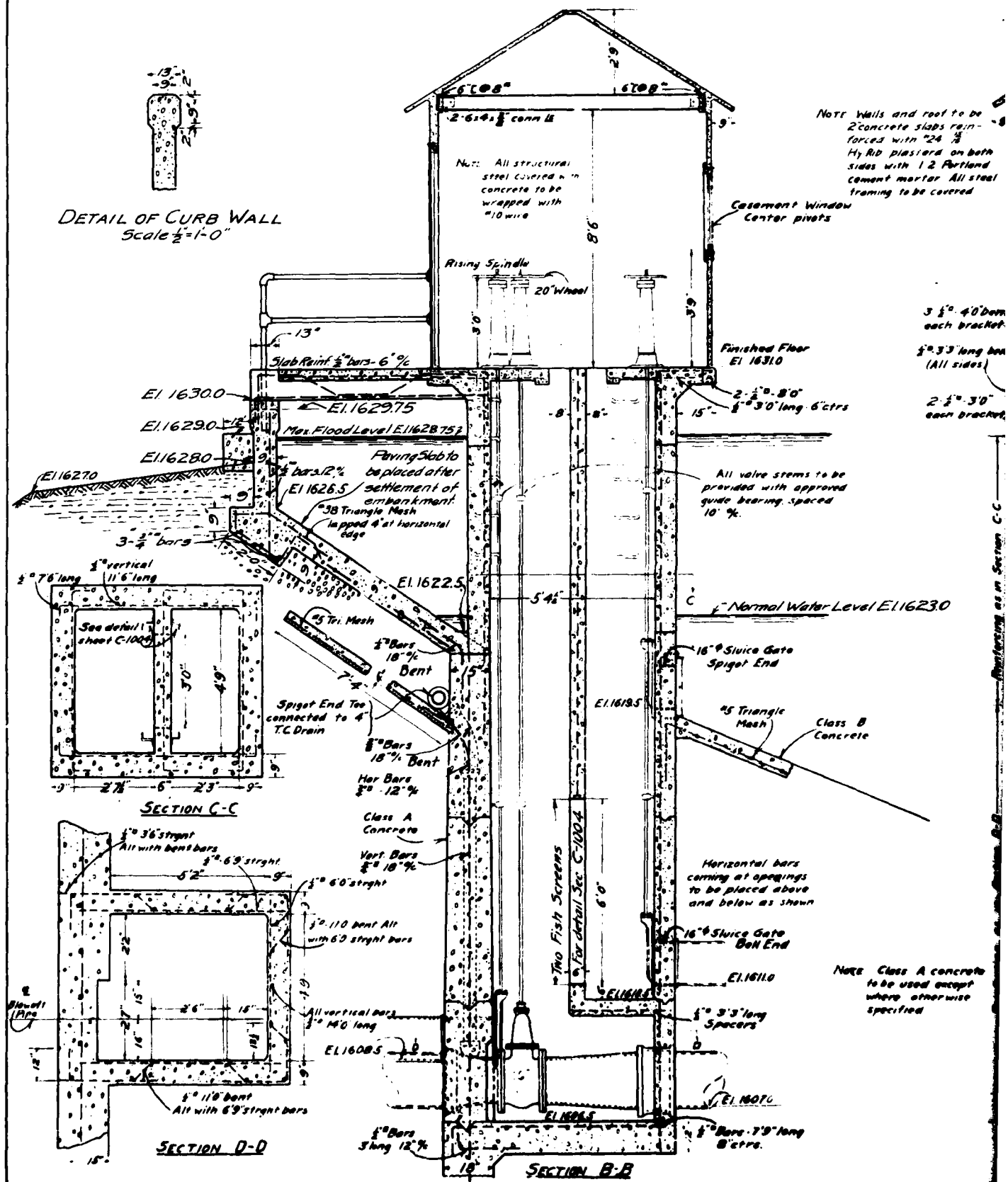


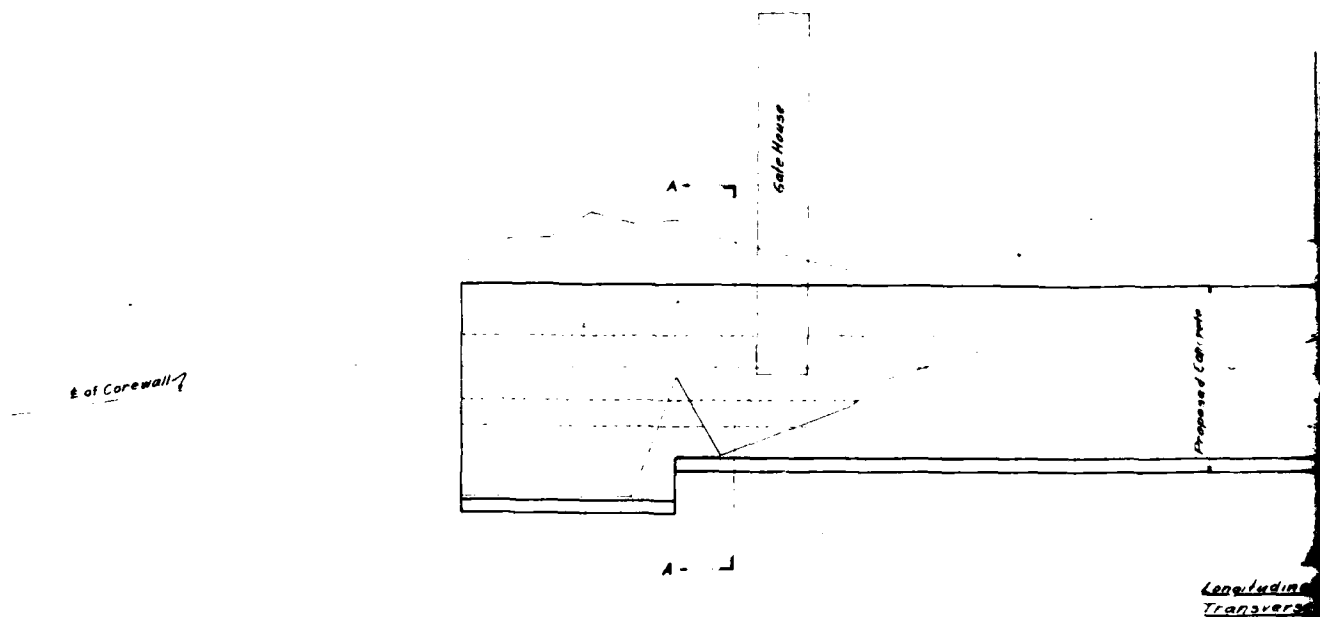
PROFILE OF WASTEWAY C-C
Scale Vertical 1"=4'
Horizontal 1"=5'



Note For Plan and Sections
See Drawings C-2531-C-4270

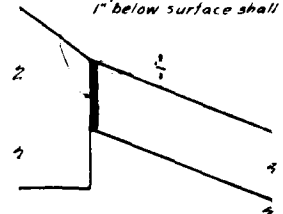
| CITIZENS WATER COMPANY OF PHILIPSBURG PA. IMPOUNDING RESERVOIR WASTEWAY CHANNELS PROFILE & DETAILS MORRIS KNOWLES, INCORPORATED ENGINEERS PITTSBURGH PA. | | |
|---|-------------------|--------|
| SCALE AS SHOWN | DATE JUNE 28 1919 | |
| DR. H. A. | 1 REV. JAN. 1920 | 2 REV. |
| TH. I. E. D. | 2 REV. | 3 REV. |
| CH. | 1 REV. | 4 REV. |
| C-1014 | | |



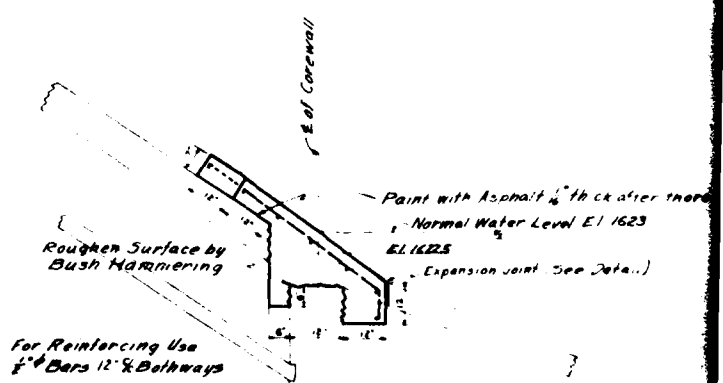


Longitudinal
Transverse

Expansion Joint shall be filled with built up asphalt joint material at least $\frac{1}{2}$ " thick, 1" below surface shall be poured.



DETAIL OF EXPANSION JOINT
Scale - 1" = 1'-0"



SECTION A-A
Scale - 1" = 1'-0"

10-6-43

Gale House

Proposed Epoxide

Line of cracks in Reservoir Apron

Spillway Wall

PLAN

Longitudinal Scale - 1" = 5'-0"

Transverse Scale - 1" = 0'-10"

E of Corewall

Paint with Asphalt $\frac{1}{8}$ " thick after thorough cleaning

Normal Water Level E1 1623

EL 1622.5

Expansion Joint (See Detail)

face by
mering

Use
downways

SECTION A-A
Scale - 1" = 1'-0"

CITIZENS WATER SERVICE CO.
PHILIPSBURG, PA.

REPAIRS TO RESERVOIR APRON
MORRIS KNOWLES

PHILIPSBURG, PA.
ENGINEERS

SCALE AS SHOWN 10-6-43

| | | |
|--------|-------------|-----|
| DR DB | REV 10-9-43 | RE |
| TW | REV | REV |
| CH CEP | REV | REV |

C-14282

PLATE VIII

203-12-12

10-6-43

12

NO. 3 DAM WALL

EL 120.74

EL 120.74

EL 120.74

EL 120.74

EL 120.74

EL 120.74

EL 120.74

EL 120.74

EL 120.74

FIELD ELEVATIONS AND LOCATIONS OF UNDERWATER INTAKES
PHILIPSBURG NO. 3 DAM

EL 120.74

EL 120.74

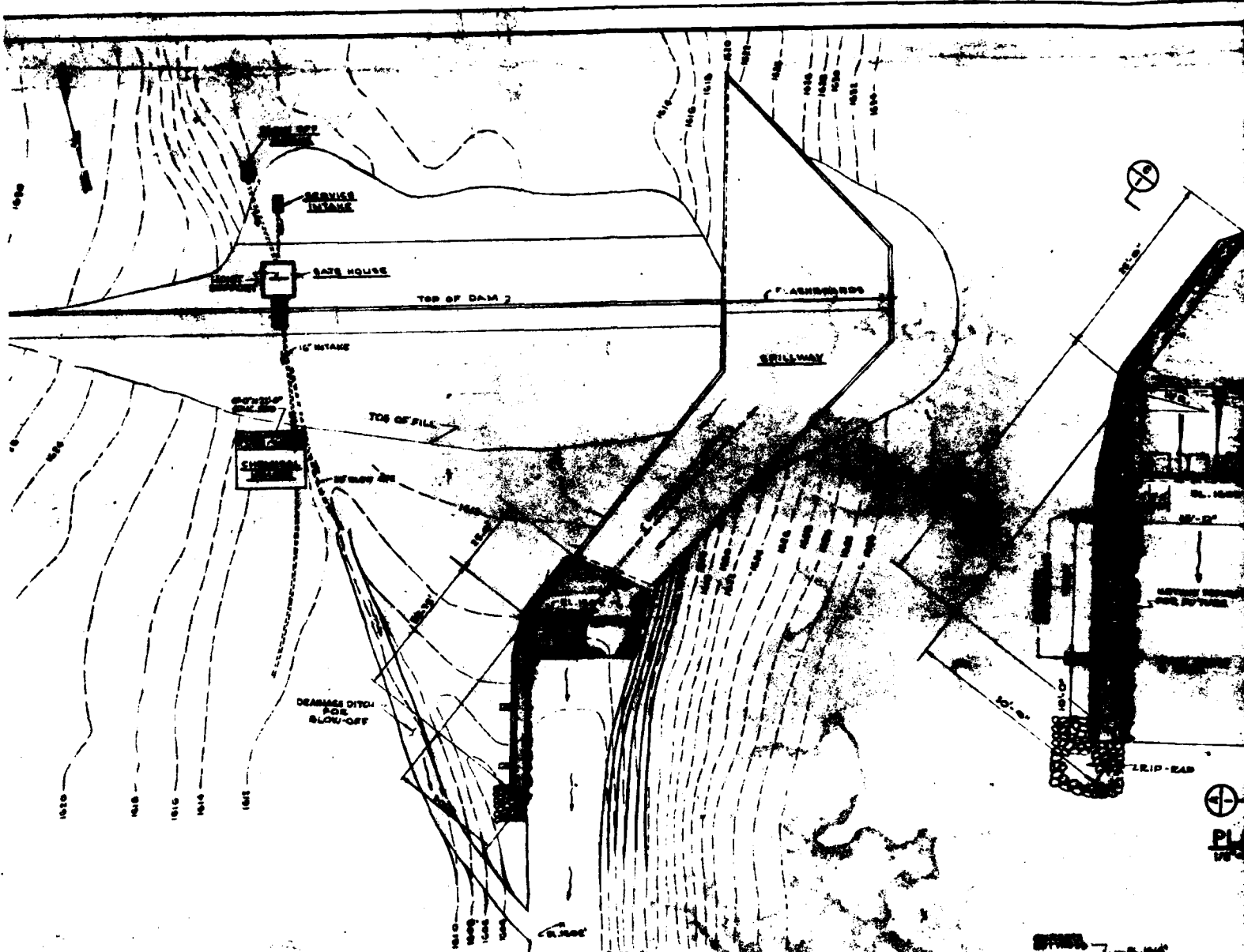
EL 120.74

EL 120.74

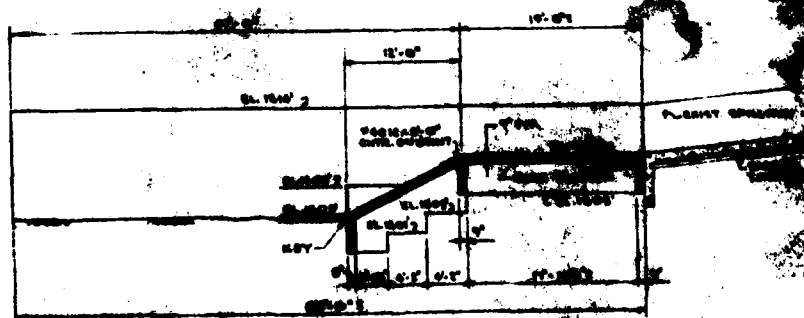
EL 120.74

| | | | |
|--|--|--|--|
| REVISIONS | | FIELD ELEVATIONS AND LOCATIONS OF UNDERWATER INTAKES PHILIPSBURG NO. 3 DAM | |
| | | KEYSTONE WATER COMPANY MOSHANNON DISTRICT | |
| | | AMERICAN WATER WORKS SERVICE COMPANY, INC. <small>CENTRAL REGIONAL ENGINEERING OFFICE</small> PITTSBURGH, PA. | |
| DRAWN AS SHOWN DRAWN BY E.G.L. APPROVED <i>[Signature]</i> | DATE 2-27-74 PROJECT DESIGNED BY CHECKED BY | 803-24 | |

PLATE D



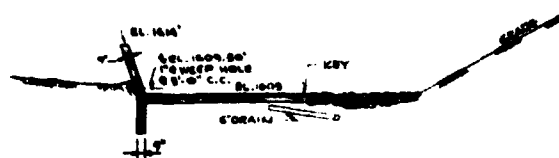
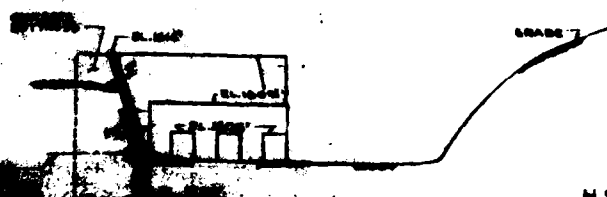
LOCATION PLAN
1" = 20'



SECTION
10'-0" = 1'-0"



SECTION
10'-0" = 1'-0"



SECTION C.
1/8" = 1' - 0"

REVISED BUT
NOT APPROVED

SECTION 1

REVISION
NO. 1
DATE
U.S.

PHILIPSBURG DAM NO. 3 IMPROVEMENTS
STILLING BASIN
PLANS, SECTIONS & DETAIL

KEYSTONE WATER COMPANY
BETHLEHEM VALLEY SYSTEM

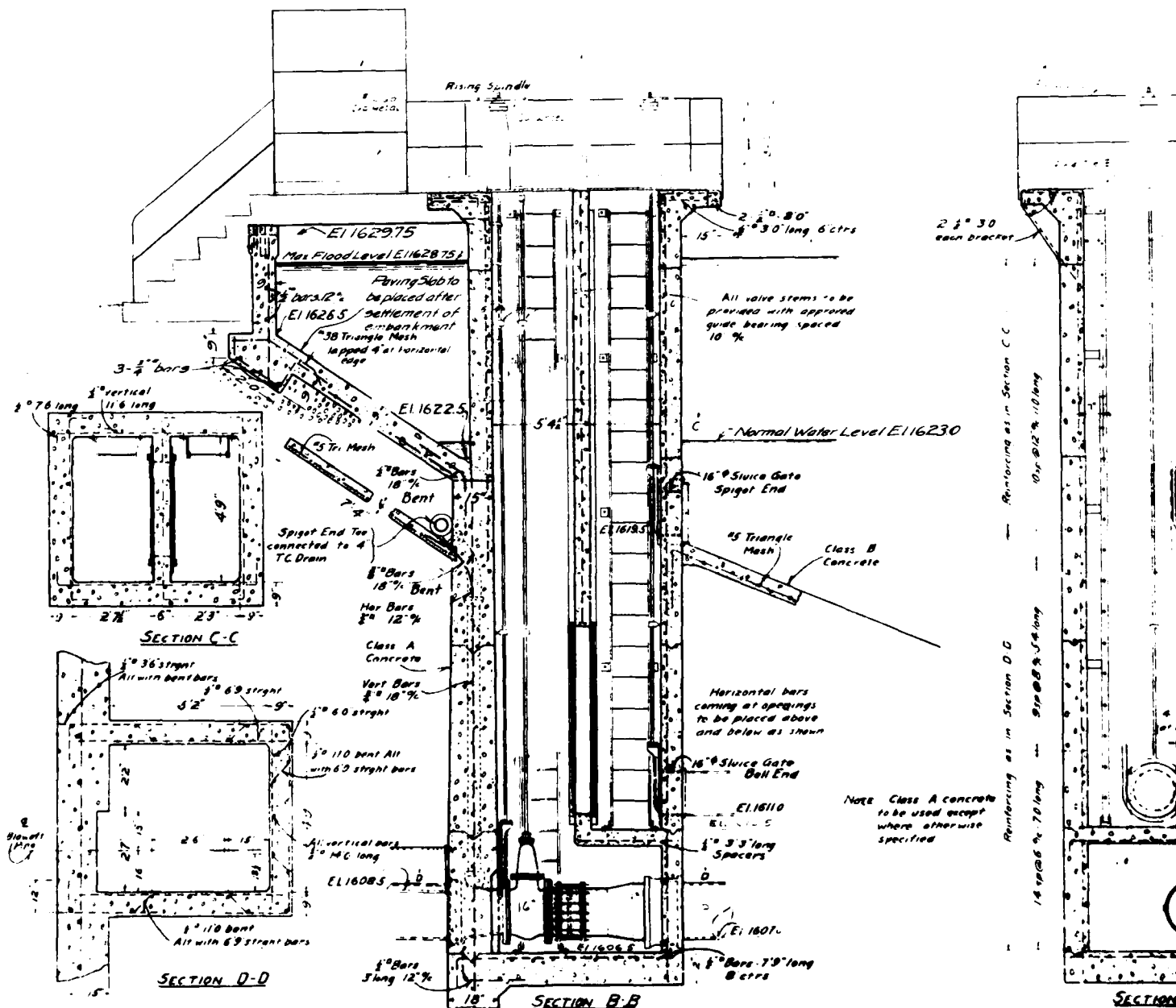
AMERICAN WATER WORKS SERVICE COMPANY, INC.
120 GROVE STREET
NEWTON, MASS. U. S. A.

DESIGNED BY U.S.S.
APPROVED

DRAWN 6-20-77 NEW CONSTRUCTION
PROJECT 6770-6 CONSTRUCTION

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

PLATE 8



21" 30
long 6 cts

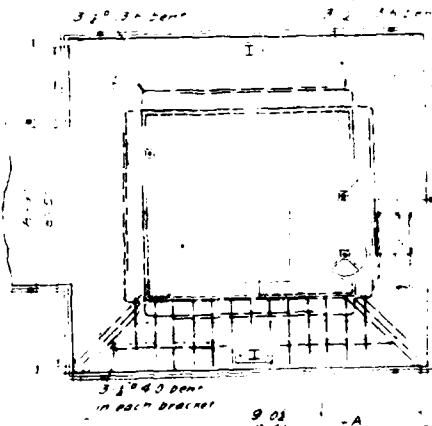
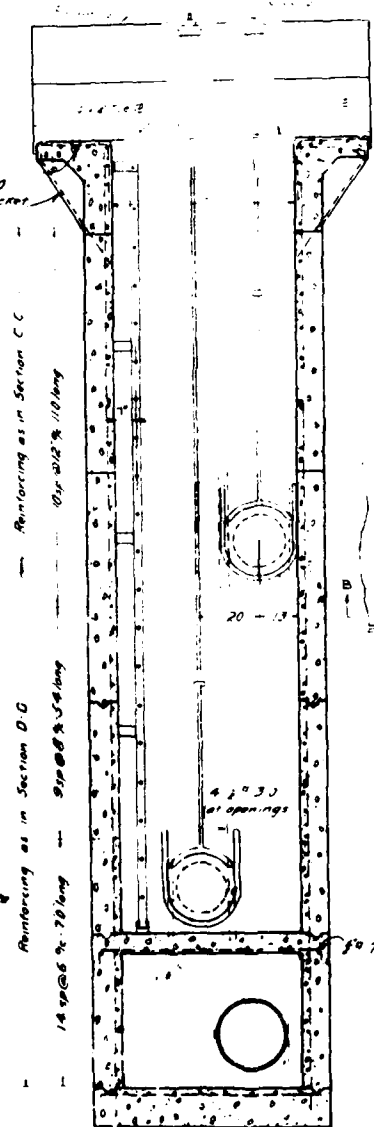
Stems to be
with approved
spaced

Water Level E116230

Class B
Concrete

bars
above
shown

Note: Class A concrete
to be used except
where otherwise
specified



FLOOR PLAN

NOTE

PROJECT WORK SHOWN SHADED.
VALVE, VALVE STEMS AND OPERATORS,
AND SLUICE GATES TO BE REPAIRED
OR REPLACED AS REQUIRED.
FOR MISC. STRUCTURAL DETAILS,
SEE M/P NO. 203-27 (4 SHEETS)

| | | |
|---|--|--|
| REVISIONS NO. 1 DATE 6-20-17 BY R.E.S. | PHILIPSBURG DAM NO. 3 IMPROVEMENTS INTAKE REPAIRS PLAN & SECTIONS | |
| | KEYSTONE WATER COMPANY MOSHANNON VALLEY DISTRICT | |
| | AMERICAN WATER WORKS SERVICE COMPANY, INC. <small>1000 N. 10TH STREET, PITTSBURGH, PA. 15222</small> | |
| | DRAWN BY R.E.S. APPROVED | DATE 6-20-17 USE DIMENSIONS ONLY PROJECT BPT-2 SCALE 1/2" = 1'-0" |
| USE APPROVED DRAWINGS ONLY FOR CONSTRUCTION PURPOSES | | 203-26-2 |

AD-A091 490

ACKENHEIL AND ASSOCIATES INC PITTSBURGH PA
NATIONAL DAM INSPECTION PROGRAM, UPPER DAM (NDI NUMBER PA-00445--ETC(U)
SEP 80 S G MAZZELLA, J P HANNAN, J E BARRICK DACW31-80-C-0026

F/G 13/13

UNCLASSIFIED

NL

2

END

DATE

FORMED

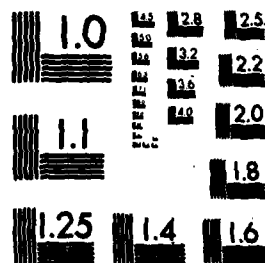
1 53

DTIC

SECRET

2 OF 2

ADA
091490



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

Physiographic Province: Upper Dam is located on the eastern edge of the Pittsburgh Plateau section of the Appalachian Plateau Physiographic Province. Rocks in this area are in a transition between the essentially flat lying rocks of the Pittsburgh Plateau and the more steeply dipping rocks of the Allegheny Mountain section.

Local Features: Cold Stream, along which Upper Dam is located, cuts a steep sided valley into the rocks near the dam site. The valley walls rise approximately 300 feet above the elevation of the dam.

Structure

Strike and Dip: The rocks underlying the dam strike about N 30° E and dip about 220 feet/mile to the northwest.

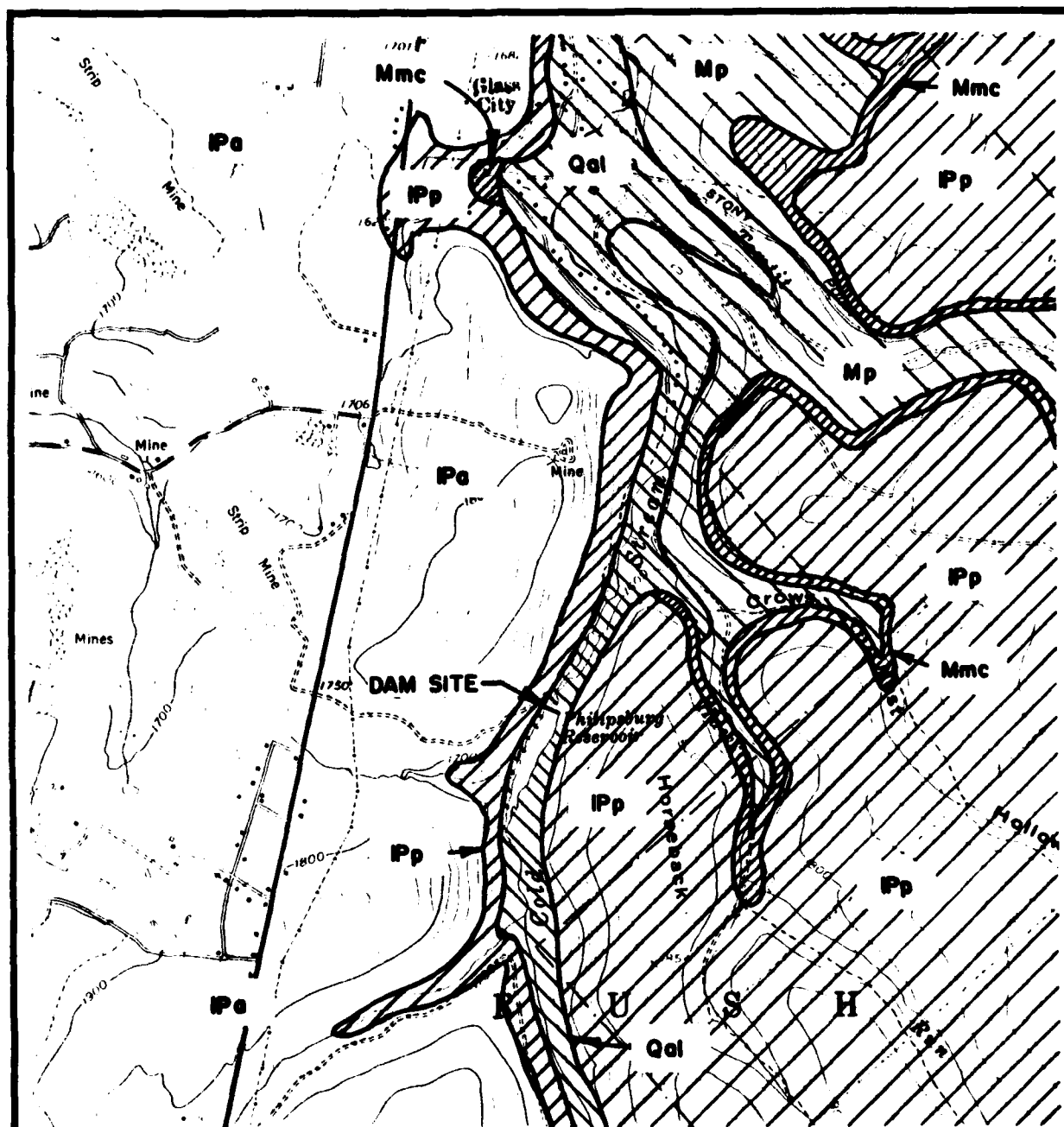
Stratigraphy

Recent Alluvium: Test pits excavated near the toe of the dam indicated that the valley bottom in this area is underlain by about 7 feet of alluvial material of recent age. The alluvial material is composed primarily of sand and gravel with some sandy clay.

Bedrock

General: Bedrock forming the valley walls just above the dam is part of the Pottsville Formation of Pennsylvania Age. The rocks on the upper half of the west side of the valley are part of the Allegheny Formation of Pennsylvania Age.

Homewood Sandstone: The Homewood Sandstone is the upper most member of the Pottsville Formation and forms the valley walls adjacent to the dam. The Homewood Sandstone generally consists of a white or light gray massive coarse sandstone.



SANDY RIDGE QUADRANGLE, CENTRE COUNTY, PENNSYLVANIA

SCALE: 0 1/2 MILE 1:24000

CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

—— FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY, GEOLOGIC MAP OF PENNSYLVANIA, 1960 and GROUNDWATER IN SOUTH-CENTRAL PENNSYLVANIA

DATE: SEPT. 1980

SCALE: AS SHOWN

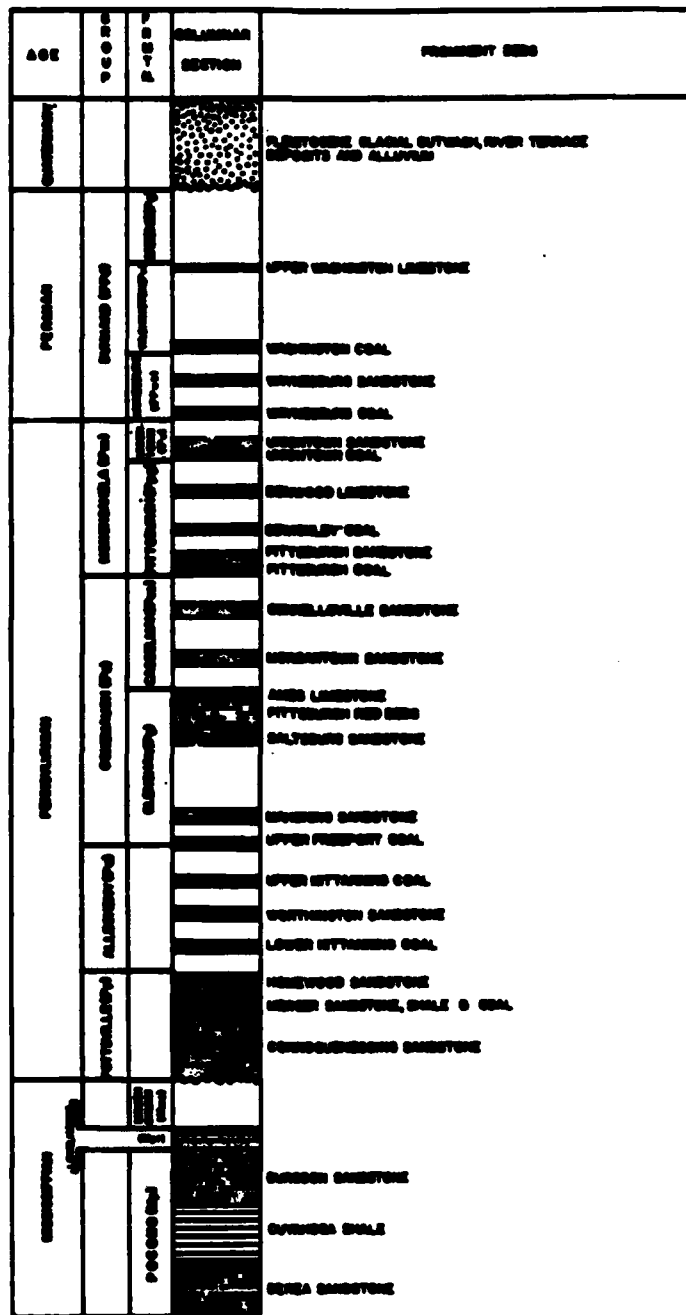
DR: JF CK:

UPPER DAM
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING

GEO SYSTEMS, INC. ENGINEERS
1090 BANKSVILLE RD./PITTSBURGH, PA. 15219

GEOLOGIC
MAP



DATE: SEPT. 1980
 SCALE: None
 DR: AP CK: JES

UPPER DAM
 NATIONAL DAM INSPECTION PROGRAM
ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS
 GEO SYSTEMS, INC.
 1900 BANKSVILLE RD/PITTSBURGH PA 15219

GEOLOGIC COLUMN